I. A. Slukhai

RUSSIAN ROCKETRY

A historical survey

TRANSLATED FROM RUSSIAN

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FOREWORD

Some years ago a new branch of the armed forces — the Strategic Rocket Force — was established in the Soviet Army. At the same time nuclear rocket arms became the property of all the other branches of the forces, and the rocketeer became a much respected person in the army, air force, and navy.

Although the rocket as a weapon is comparatively "young", it has a great fighting history, having originated in ancient times when Russia fought off many foreign invaders.

Particular fighting glory was gained by our soldiers and officers during the Second World War. Then thundered the mighty salvoes of the "Katyushas" and the naval and air borne rockets.

And, finally, the whole postwar history of rocket development constitutes one of the brightest chapters in the annals of the Soviet nation's achievements in science and labor. Our numerous victories in space, and the unrivaled flights of the intercontinental missiles of most deadly accuracy and length of range speak louder than words.

Lately the Soviet press has well presented the broad picture of our pre-eminence in the theory and practice of rocket development. In books, journals, and newspapers appear ever more frequently the names of scientists and inventors, who are blazing the trail of research and development with new concepts and ideas. The Soviet reader is now better informed than ever before about the exploits of the first rocket units in the fight against the German fascist invaders.

Yet, in spite of the various publications dealing with rockets and rocketeers we know all too little about the enthusiasts who designed rockets, and the heroes who made them renowned. The reader needs a book in which the history of rocketry is intertwined with the story of those who dedicated their lives to science, and who served devotedly in the rocket forces. It seems to me that this book at least partially answers this need.

What is the book about? First of all it explains the contribution of our scientists and designers to world science and practical rocket construction. The author does not attempt to describe the entire history of rockets from the beginning as an item of entertainment, ending with the rocket engines of spaceships, but he tells us about all the most astounding discoveries and the inventions of decisive importance.

The reader learns about the first successful rocket launchings, the first "Katyushas", and the first rocket carriers. He gets acquainted with the people who sat in the cabins of the first jet planes, and hears about the self-sacrificing exploits of the rocketeers on the battlefield

and at the time of exploring new techniques. The reader meets as friends those who control present-day rockets.

The revolution in the art of warfare, which has affected every aspect of army life, finds expression first and foremost in the fact that all the different branches of the armed forces are being equipped with nuclear rocket weapons. But the rocketeers, who now have in their hands the most powerful weapon of all, have still something to learn from other soldiers, especially those that participated in the Second World War: fortitude, endurance, courage, unbounded devotion to the homeland, and faithfulness to their military duties.

It is pleasant to see how our rocketeers like to learn about the heroic history of their predecessors, and collect every scrap of information about the exploits of those "masters of rocket fire."

This book will not only be interesting to our soldiers but is also something that they need. It will help them to become better acquainted with the history of rocket weapons, to know more about the people who designed them, tested them, and used them for the first time in actual fighting.

Lieutenant General I. F. Khalipov

THE PIONEERS

The history of rockets is a great, interesting and glorious epic. It is difficult to say precisely when and where rockets originated but it is known that there were rockets in ancient India and in ancient China. One thing, however, is certain: many of its brightest aspects are closely connected with Russian craftsmen and with Russian engineering.

Those who conducted research into the history of Russian rocket technology stated that our country had rockets as early as in the fifteenth century. It is true that the first rockets were only the work of individual gifted craftsmen in bondage and were made in the most primitive way, but although these rockets were very simple they fulfilled their purpose well and were successfully used for fireworks at various celebrations. As time went on, rockets found more applications, their design was improved and their operation was perfected. Already at the beginning of the seventeenth century the gunpowder experts had explored all the fundamental secrets of rocket production and had learned to apply them widely, not only for fireworks but also as a means of illumination and ignition.

From generation to generation the Russian craftsmen carefully handed down the accumulated experience and the secrets of producing and using rockets, and soon written evidence of rockets appeared. Thus, between the years 1607 and 1621 the Russian gunsmith Onisim Mikhailov wrote "Ustav ratnykh, pushechnykh i drugikh del, kasayushchikhsya do voennoi nauki" (Code of Military, Artillery and Other Matters Pertaining to the Science of Warfare).

This, the oldest preserved written document dealing with artillery, contains a detailed description of Russian rockets or, as the author of the "Code" calls them, "cannon balls which run and burn."

Onisim Mikhailov's "Code" is very interesting. In the detailed instructions for Russian artillerymen, which it contains, rockets are also dealt with. Here is an excerpt from the "Code":

"Information on the cannon balls which run and burn. Take five parts saltpeter, two parts flammable sulfur and one part charcoal, and make a fine powder from them. Then take the powder, as much in weight as charcoal, and mix thoroughly. Then soak the powder in good wine... or vinegar and make a bag from kid or goat skin which has to be light and clean... Soak this bag well in the wine or vinegar. First fill it with musket powder, in the midst of which put mercury..., then shut the bag well and hang (it) on a sunny day in the sun or in a warm chamber, until it dries and becomes very hard."

Then the author of the "Code" recommends making a small hole (depression) in the powder propellant of the rocket"... and put a small fuse in." If after that some dry powder is poured into the recess and ignited,

"it will run hither and thither and burn fiercely. Such a device can be made into a burning cannon ball and hurled from above, or projected by some means into a castle."

No less interesting is the testimony of other Russian artillerymen, M. V. Danilov, A. P. Demidov, F. S. Cheleev, which contains rich factual material. From this we can see the service rendered by these native masters of pyrotechnics to rocketry and how they laid the foundations of its further development. These documents, like the "Code" by Onisim Mikhailov, prove convincingly and indisputably that even in that remote past rockets in Russia were used not only for firework entertainment, but also for military purposes in the role of an artillery weapon as well as for illumination [flares] and incendiary purposes.

Even more attention was given to the development of rockets in Russia when Peter I came to power. Ascribing enormous importance to increasing the might of the Russian state, Peter I studied in great detail all aspects of military engineering. He personally supervised the development of military practice, and established the first rocket institute in the country where standard signal and illuminating rockets were made for the Russian army.

A Russian scientist who made a great contribution to the development of solid-fuel rockets was General Alexander Dmitrievich Zasyadko.

The military rocket made by Zasyadko was a great improvement over its predecessors as regards design and military value. Its technical properties proved to be much better than those of contemporary rockets in Western Europe. It is therefore not surprising that the new rocket was incorporated as a weapon and used with some success not only by the land forces, but also by the ocean fleet of nineteenth-century Russia.

Zasyadko's solid-fuel rockets were first used in actual fighting against the Turks in the war which began in April 1328. The rockets were used successfully in the siege of the fortresses Varna, Shumla, Silistra, and Braila.

Memoirs, reminiscences and letters by eyewitnesses, preserved from that time, contain interesting descriptions of how the first Russian rocketeers acted under conditions of war, and of what was new in what they introduced in the way of tactics together with the use of rockets. Here is one of these reminiscences.

The Russians got ready to attack the fortress of Varna which was the keystone of the Turkish defense. To have the best possible chance of success, the army command decided to use its new weapon: rockets. General A. D. Zasyadko and Lieutenant Colonel V. M. Vnukov, the heads at that time of the Russian rocket establishments, took an active part in preparing for the coming battles. They helped the commander of the rocket company, an officer named P. P. Kovalevskii, to instruct the soldiers in the use of the rockets, and they personally observed how the rockets performed in the fighting.

The Russian army command decided to mount the main attack on the fortress of Varna from the north. The main part of the artillery was therefore concentrated there.

In one of the gulleys to the north the rocket company commanded by Kovalevskii took up firing positions, but five rocket launchers were detached to fire at the enemy from the south side.

Russian troops fire rockets at the fortress of Varna, held by the Turks (1828).

At dawn on 16 September 1828, everything was ready for the attack on the fortress. The artillerymen took up their positions next to their guns. The rocketeers also were in a state of full alert; the rockets were placed inside the iron tubes; the pyrotechnicians with their fuses were ready at the launchers to put them to the rockets at the first command.

As soon as the order "Fire!" had been given, the Russian artillery joined in the fighting. Then the rocketeers fired with powerful effect. They fired at fortified buildings with surprising accuracy, widening the breaches caused by the artillery. The rocket fire was especially effective in crushing the reserves, which the enemy brought up from deep within his defenses.

Encouraged by the results of the artillery and rocket fire, the infantry entered the fight. Soon the first bastion fell before the impact of the Russian forces. The rocketeers quickly moved forward, took up new positions, and opened fire on the inner parts of the fortress, thereby causing it to become a sea of flames and throwing the defenders into utter confusion.

The rocket fire, used for the first time in combat, was employed both on the northern and southern sides of the fortress, and was extremely

effective. The Russian army command formed a very high opinion of the new weapon. Urgent measures were taken to increase rocket production.

Officer P. P. Kovalevskii, commander of the first rocket company.

Nor were the rocketeers forgotten. Many of them were mentioned in dispatches, and the Russian officer Kovalevskii in recognition of the successful performance of this first rocket company and of his personal bravery was decorated. So emerges the first rocketeer definitely known to us, who for his effective use in action of the new weapon and for his courage received high recognition.

In many subsequent battles with the Turks Kovalevskii's mobile rocket units always played a major role in attaining victory.

The effectiveness of rocket fire and its stunning power were well described by Captain Vakul'skii who, as well as being an eyewitness of the rocketeers' exploits, himself commanded a rocket battery.

"As far as I can judge, there is no cavalry in the world which would not be put to flight by a few well-placed rocket salvoes. The horses cannot stand the hissing and the fire of the rockets in flight. I had a war-tried horse; gunfire did not affect it at all, but when I sat on it after the action of the rockets, I felt that it was trembling all over... I do not say that rockets are as effective as cannon balls..., but their effect on the morale of the cavalry is certainly greater than that of grapeshot."

In the Russo-Turkish War of 1828-1829 Russian vessels armed with rockets designed by A. D. Zasyadko operated successfully in the Black Sea and on the Danube.

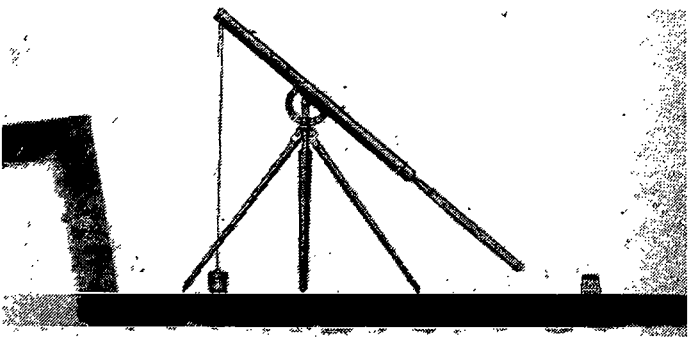
Toward the middle of the nineteenth century the development of rockets in our country was further advanced. They had long ceased to be the concern of some gifted craftsmen and had acquired national importance. In St. Petersburg a special rocket institute was founded. Large funds were released for rocket production. Leading military men and scientists began to take an active part in the design and production of rockets.

In 1849 the rocket institute in St. Petersburg, then already well-known in Russia and abroad, was headed by a general of the Russian army, the scientist and artilleryman Konstantin Ivanovich Konstantinov (1819-1871). He played a leading part in the successful and rapid solution of the many problems of building up the rocket artillery.

Konstantinov worked with indefatigable energy and persistence to improve the Russian rockets. He had a considerable share in the modernization of rocket production, and he made their production process safe.

Before that, in 1847, he built a rocket ballistic pendulum, with which he determined the effect of the shape and design of rockets on their

ballistic properties, laying the scientific foundations of rocket calculations and design. New scientific discoveries, many improvements, investigations and experiments enabled him within a short time not only to improve the old rockets but to build new ones. These were often better than foreign rockets as regards their small weight, mobility, firing rate, range, and ease and safety in handling. The valuable military properties of the rockets designed by K. I. Konstantinov were very clearly shown in the defense of Sevastopol in the Crimean War 1853-1855.



Drawing by K. I. Konstantinov of a launcher for two-inch rockets.

While directing large-scale, yet safe, rocket production Konstantinov also spent much time on training rocketeers, organizing rocket batteries and working out the tactics of rocket operations.

The narrow, one-sided, purely military use of rockets did not satisfy the inquisitive mind of the scientist. Seeing the wider potentialities of rockets, he did much work to develop these, and in 1862 he designed, built and tested a rescue rocket for shooting lifelines to shipwrecked vessels. This rocket was much better than the English one, which until then had been considered to be the best. Encouraged by this new success Konstantinov went further; on the basis of the scientific knowledge of that time he discussed in one of his theoretical works the question of developing a rocket engine for airplanes.

In spite of the well-known sluggishness of the Czarist regime Konstantin Ivanovich Konstantinov's work was widely acclaimed. Moreover, it crossed the borders of the country and gained fame abroad. The Russian scientist received many Russian and foreign decorations for his achievements in rocket design.

Konstantinov's scientific work, his practical achievements in the field of rocket design, together with the work by other Russian inventors working on this problem, led to a further development in rocket techniques and scientific knowledge, and to a whole series of original ideas for rocket-propelled flying machines.

Most noteworthy in this connection are the Russian inventors I. M. Tretesskii and N. S. Sokovnin who were the first to propose the idea of utilizing the reaction of a jet of steam or compressed air for propelling flying ships lighter than air in the atmosphere, i. e., dirigibles.

The idea of using a rocket engine in a heavier-than-air flying machine was also born in our country. It was put forward by the famous Narodnik* revolutionary Nikolai Ivanovich Kibal'chich (1854-1881), an active participant in a terrorist action carried out by "Narodnaya Volya"** on 1 March 1881, which resulted in the killing of Czar Alexander II.

N. I. Kibal'chich.

The entire life of N. I. Kibal'chich, that remarkable man and citizen, was indeed heroic. From his early youth he excelled by his great industriousness and thirst for knowledge. Among his friends and contemporaries Kibal'chich was considered to be one of the most erudite and versatile people. From 1871 to 1875 he studied at the Institute of Communication Media and at the St. Petersburg Academy of Medicine and Surgery, and he spoke fluent French, English and German.

Toward the end of 1875 Kibal'chich was arrested for harboring forbidden literature, and he spent about three years in jail. In 1878 he first joined the organization "Zemlya i Volya"†, and later the "Narodnaya Volya," where he headed the laboratory for the production of bombs, mines and time bombs. Here especially he conceived the idea of using a reaction-driven engine in a flying machine heavier than air.

This, the first proposal in the world for a rocket plane with a solid-fuel rocket engine, was described by Kibal'chich in a note written in the death cell ten days before his execution.

He wrote: "Being locked up, a few days before my death, I am setting down this project [on paper]. I believe that my idea can be realized, and this faith supports me in my terrible situation. If my idea, after careful scrutiny by scientists, will be considered feasible, I will be happy in the knowledge of having done a great service to my country and mankind. I will then calmly face death, knowing that my idea will not perish with me but will be realized by mankind for which I was ready to sacrifice my life."

Kibal'chich's jet-propelled flying machine was a platform carrying strong pillars with a powerful rocket-type solid-propellant engine. It was assumed that the flying machine would be lifted and driven by the reaction effect of a jet of gases, generated by burning powder in the rocket engine, which would have to be turned to control flight direction. Together with the idea of controlled rocket flight, especially important and valuable were his instructions that in the rocket engine slowly burning powder had to be

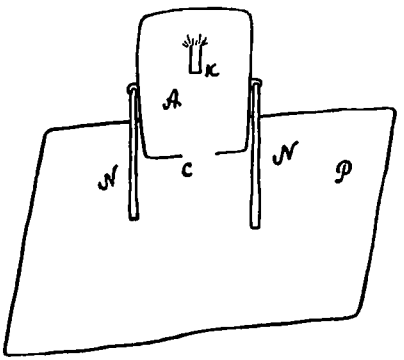
* [Narodnik — a member or follower of the Narodovoltsy, populist terrorists of the organization Narodnaya Volya (People's Freedom).]

** [See footnote above.]

† [Zemlya i Volya — Country and Freedom.]

used in the form of very compressed squibs which had to be successively fed into the combustion chamber.

This project, containing a most valuable and important idea, was filed away by police officials together with the "Action of 1 March" and did not become known at the time. Only after 36 years, in August 1917, were the notes of the patriotic inventor discovered in the police archives and were then suitably appreciated. They were published for the first time after the 1917 October Revolution.



Sketch drawn by N. I. Kibal'chich of his flying machine.

Rockets were also used in the navy. In 1834 at the Alexander Foundry in St. Petersburg the armored submarine vessel designed by A. A. Shil'der was built. The armament of the submarine consisted of a mine and six rockets which could be launched under water against objects on the ground and above water. For detonating the mine and launching the rockets from the submarine electric energy was used for the first time.

For transporting boats by water, A. A. Shil'der designed a floating base (pontoon) equipped with the same kind of rocket launchers as were used in the boat. Thus the floating base used for towing submarine boats was the work of this Russian inventor.

The inventor A. I. Shpakovskii, working in the mine workshop in Kronstadt, constructed the world's first jet-propelled torpedo at the end of the 1870's.

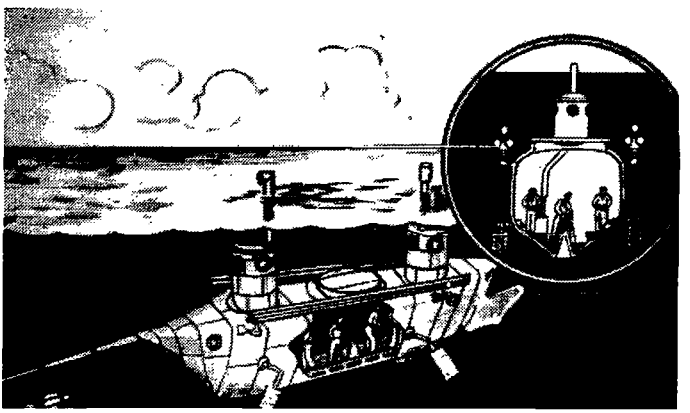
It must be frankly pointed out, however, that all the work connected with the design, construction and utilization of rockets at that time hardly proceeded past the experimental stage and concerned mostly solid-fuel rockets. Apart from that, the rapid development of artillery at the dawn of the twentieth century, accompanied by a considerable improvement in its military value, caused reaction weapons to be temporarily abandoned because their tactical and technical properties were far below those of the artillery, especially in such decisive points as accuracy and range.

This explains why at the beginning of the twentieth century comparatively little work was done on the improvement of rocket techniques either in Russia or abroad. This necessarily affected the application of rockets for military use. It suffices to say that in the Russo-Japanese War and in the First World War there were only isolated instances of the use of rockets as weapons of war. In the war against Japan the Russians used rockets only for illumination. This is what was written about it by the famous Soviet writer A. Stepanov in his historical work "Port Arthur".

The rocketeers " .. pulled up the mobile launchers, put a rocket in each and ignited the fuses... The fire slowly crept up the thread, and the rockets, crackling and leaving a trail of sparks, flew upward. Bursting

in the air into thousands of fiery stars, they clearly illuminated the forward positions."

Illuminating rockets were also used in the First World War. It is true that the Russian soldiers with their inborn ingenuity sometimes replaced the illuminating equipment by hand grenades and thus endowed the rockets with a different purpose. However, this was only an episode. There were attempts during that war to arm light boats and even airplanes with rockets, but these experiments were not very successful and were soon abandoned.



A. A. Shil'der's submarine in submerged position.

However, it would not be correct to say that at the beginning of the twentieth century no one was thinking about rockets. In particular, Konstantin Eduardovich Tsiolkovskii and Ivan Vsevolodovich Meshcherskii at that time by their investigations laid the foundations of new scientific branches, rocket dynamics, and mechanics of bodies of varying mass. A number of problems, essential for the development of rocketry, were solved by the father of Russian aviation, N. E. Zhukovskii.

In his works published in 1897 and in 1904, Meshcherskii derived the basic equations of the dynamics of a point of varying mass.

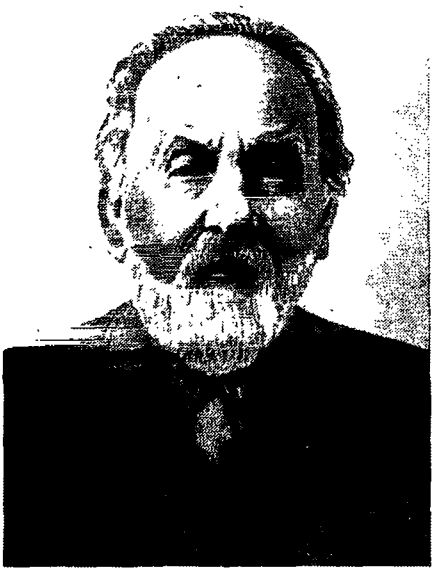
K. E. Tsiolkovskii worked out in detail the dynamics of linear motion of long-range rockets with liquid-fuel reaction-driven engines.

This great scientist had a thorny and difficult life. He was born in 1857 in the village of Izhevskoe in the Ryazan Province. After a grave illness in his childhood he became almost completely deaf. But in spite of the difficulties he had to overcome, Tsiolkovskii was engaged as early as 1883 in scientific work.

Tsiolkovskii's principal works are concerned with three basic problems: the scientific substantiation of an all-metal aerostat, an efficiently streamlined airplane, and rockets for interplanetary flights. But most of all he worked on the theory of jet propulsion and space travel.

As early as 1883 Tsiolkovskii had suggested the application of the principle of jet propulsion for flying.

In 1903 this outstanding scientist proposed a liquid-powered reaction-driven engine which contained all the basic elements of contemporary liquid-fuel rocket engines: fuel feed by pumps, a combustion chamber cooled by one of the liquid fuel components, and a widening jet nozzle.



K. E. Tsiolkovskii

Also in 1903 in the article "Issledovanie mirovykh prostranstv reaktivnymi priborami" (Study of Space by Jet-Propelled Devices) he submitted a plausible and clear theory of rocket flight with a view to the change of mass in the course of its motion, and he also substantiated the use of jet-powered apparatus for interplanetary journeys.

It is not without interest to note that Western science arrived at the same conclusions much later. Thus the French research worker Esnault-Pelterie repeated Tsiolkovskii's idea 10 years later, in 1913, and the American scientist Goddard in 1919.

Having made a profound study of rocket flight, Tsiolkovskii was the first in the world to derive a formula of rocket motion. He obtained an equation which translates a physical phenomenon, rocket flight, into the precise language of mathematics.

Calculations using Tsiolkovskii's formula showed that the speed and range of a rocket depend on the speed of the gas flow and the ratio of initial to final weight of the rocket. In other words, the secret of high speed and great range of rockets lies in an increase in the speed of the gas flow, high-energy fuel, and small weight of the rocket itself compared with the weight of the fuel.

The important and famous discoveries made by Tsiolkovskii may be truly regarded as heroic feats on the part of the scientist. Living in difficult conditions, at that time without sufficient means not only for his scientific experiments but even for his daily needs, he achieved so much that he is properly considered the pioneer, the father of contemporary rocket engineering. As one of his pupils and followers, Professor A. A. Kosmodemyanskii, rightly said of him: "The idea of using rockets for solving scientific problems, of applying the principle of reaction to actuate spaceships is Tsiolkovskii's. He is the father of the contemporary liquid-fuel long-range rockets, one of the founders of a new chapter of theoretical mechanics."

After the revolution Tsiolkovskii's activity became even more fruitful. The Soviet regime took a great interest in his scientific discoveries and assisted him in every respect; this inspired him and lent him strength and energy enabling him to develop his faculties in all their power and

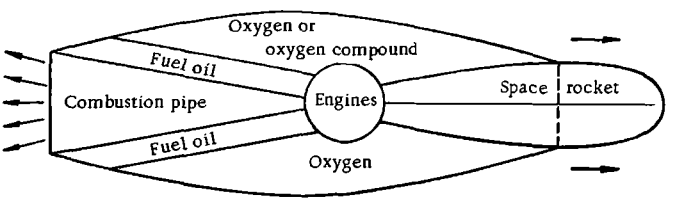
brilliance. Thus we find that from 1917 to 1935 four times as many works by Tsiolkovskii were published as during all the prerevolutionary period of his activity.

In 1929 Tsiolkovskii worked on a very important problem which, even now, has not lost its topicality, i.e., the theory of tandem and multistage rockets. He solved the problem of rocket motion in a homogeneous gravitational field and calculated the fuel supply necessary to overcome the gravitational pull of the earth.

This pioneer of rocket flight became the acknowledged head of the Soviet school, a teacher who passed on his knowledge to many Soviet scientists and engineers subsequently active in rocket engineering.

Konstantin Eduardovich Tsiolkovskii mapped the course of development of rocket engineering from experimental rocket engines to long-range rockets, including those carrying human crews.

This great scientist carried out much diversified work dealing with interplanetary rockets. Within a comparatively short time he designed ten different types of interplanetary rockets, from a small experimental rocket to a huge tandem rocket for dozens of passengers; he proposed a number of devices for training the future space travelers, worked out a method for launching space rockets and their safe descent, considered living conditions on board an interplanetary rocket, and provided for everything including communication with the earth.



Earth rocket carrying a space rocket (according to a drawing by K. E. Tsiolovskii).

It was, in particular, Tsiolkovskii's research into interplanetary communication which for the first time established strictly scientific proof that flights at cosmic speeds were possible. He was the first to investigate the problem of rockets as artificial earth satellites and to propound the idea of extraterrestrial stations as intermediate bases for interplanetary travel.

Tsiolkovskii's bold yet scientifically well-founded ideas aroused great interest among Soviet people. The editorial offices of newspapers and the scientist himself received many letters showing a spirit of healthy inquisitiveness. People wanted to know as much as possible about Tsiolkovskii's work, about his bold and audacious ideas and the methods by which they could be put into practice.

K. E. Tsiokovskii freely gave information about his scientific achievements and even his aspirations; he spoke about them at many meetings and published many articles. Three months before his death a reporter of a Moscow newspaper visited him. The great scientist received him readily and told him about his work:

"Nowadays there is a lot of talk about flying into the stratosphere. Our courageous pilots have already attained a height of 22 kilometers. A heroic ascent! ... My new work is mostly concerned with designs of machines capable of flying outside the atmosphere. The next step from "stratostats" are jet-propelled machines... Such machines can be of two types: those which take off vertically without wings and return under the control of self-regulating (automatic) devices, or those which are designed like an airplane with airplane-type controls and a pilot's cabin, and which take off at an angle. Either the cabin would be sealed, or the crew would have to wear space suits. Such jet-propelled machines are independent of the thinning of the atmosphere, and they can fly not only in the stratosphere, but even beyond it.

"My new work is the result of many years of previous labor... But there is still much work to do before it is possible to completely conquer the stratosphere, and to eventually travel beyond it. This can only be done in our country, in the Soviet Union."

Only now that such gigantic strides have been made in rocket engineering is it possible to fully appreciate the achievements of the scientist and the boldness of his heroic mind, which half a century ago saw the rocket as the future space vehicle, the means of realizing mankind's age-old dream of reaching cosmic space.

The works by the outstanding Soviet scientist K. E. Tsiolkovskii proved to be the theoretical basis for the entire contemporary rocket engineering. On the basis of his work Soviet scientists, engineers and workers built the most powerful rockets and jet engines in the world and advanced our country to the first place as regards the conquering of space; this also enabled us to greatly increase our defense potential.

From all that has been said we can see that present-day rockets so well-known to all the world did not originate in some sudden unexpected way from nowhere, but were rather the logical result of lengthy and determined research by gifted scientists and engineers extending over several centuries. The superiority of our rockets in their tactical and technical qualities over the rockets of foreign countries has already become traditional. This tradition goes back to the time when rockets appeared for the first time. It still holds true that rockets are one of the most formidable weapons and the most important means of conquering outer space.

A noteworthy tradition is also that our Russian scientists, in their work on the design, construction and improvement of rockets and jet engines, never confined themselves to narrow goals and in particular did not restrict themselves solely to the military aspect. They endeavored to utilize their successes in this field in the wider context of the whole of the nation's needs in which the military aspect is included as one of the means of defending the country's interests.

While attentively following the history of the development of rockets we cannot but notice the great love of the rocket enthusiasts for the work that they pursued so self-sacrificingly. When we were describing the work of individual scientists, engineers and technicians, or even, perhaps, ordinary Russian craftsmen, it is difficult to say which of them achieved the most in this field, but we can say with full conviction that every one of them, living at different times, ardently loved his work and devoted to

it all his knowledge, strength and ability. We may add that this tradition has not become weaker over the years, but, on the contrary, it has continued to be maintained even more strongly by Soviet rocket engineers.

Only unbounded love for their work, faith in the inexhaustible possibilities of the Soviet socialist system enabled our gifted scientists, engineers and technicians to achieve results in rocketry such as the greatest minds of mankind could only dream about in earlier times.

History left us few examples of how rocket weapons were studied, constructed and introduced in fighting by Russian forces long ago. Even more scanty are the records of names of rocketeers who used the new weapon on the battlefield. However, even the few facts at our disposal are sufficient for us to envisage the self-sacrificing spirit, courage, and heroism shown by the "miracle heroes" who fought for the good of their country. The exploits of the rocketeers of those times did not attract special attention among the military achievements of the other forces of our country, nor did they have any special features characteristic only of them, but it can be confidently said that those exploits were no less great, and therefore they can and must serve as an example for the soldiers, sergeants and officers of the Soviet army and navy, who today stand by their rocket weapons, safeguarding the peaceful work and happy life of the Soviet people.

THE FIRST SOVIET ROCKETS

From the first days of its existence the Soviet state organized systematic and purposeful work concerned with the further development of research in jet propulsion.

The Soviet government headed by V. I. Lenin lavished attention on the scientists. Especially great consideration was accorded K. E. Tsiolkovskii and other scientists. The attitude toward his work is a notable example of how highly the Soviet socialist state regarded science from the first days of the revolution.

"It was not until after the Revolution," Tsiolkovskii wrote, "... that the attitude toward me changed, and I was able to enjoy working freely in conditions of normal relations."

The appreciation by the Soviet state of Tsiolkovskii's great merit, publication of his works and the popularization of his achievements had a positive influence on the recruiting of new forces in the field of rocket engineering. A number of gifted pupils and followers appeared at his side.

They not only enthusiastically and thoroughly studied the teachings of Tsiolkovskii and his predecessors, but also undertook extensive experimental work to put into practice the ideas of the great scientist, taking practical measures to develop these ideas further by the construction of rockets and jet-propelled planes, and constantly sought and found ways and means for their improvement.

One such successor in the work to which Tsiolkovskii had devoted his life was the glowing enthusiast of space flights Fridrikh Arturovich Tsander. He gave much energy to the work on technical problems of space flights and the practical development of rocket engineering. He had studied problems of jet propulsion since 1908 and achieved much in this field. As early as 1920 this gifted inventor designed a spaceship and gave an exciting account of it at a conference of inventors and innovators of Moscow Province.

It so happened that at this conference Vladimir Il'ich Lenin took part. Tsander wrote about this meeting with the leader: "After my speech I was invited to meet V. I. Lenin. I was very uneasy. But Vladimir Il'ich spoke so simply and cordially about my work and my plans for the future that I took up much of his time and told him in great detail about my work and my vision of building a rocket-propelled spaceship.

"I told Lenin enthusiastically that I did not only work on the design of a spaceship, but that I thought much about how and under what conditions man will be able to fly to Mars; how he will be able to stand the acceleration, what he will wear in flight, what he will eat, and so on and so forth.

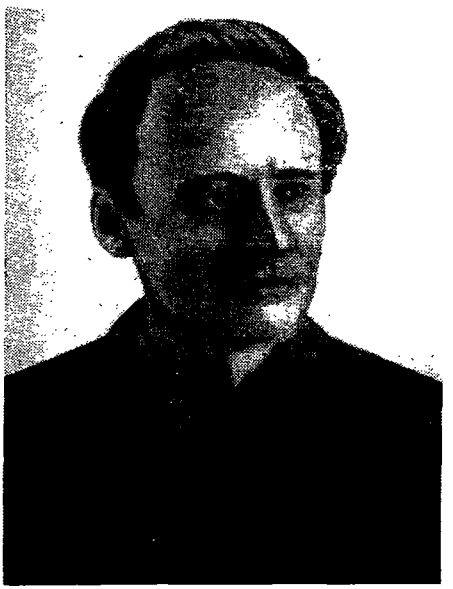
"Then Lenin asked me: And you will be the first to fly?

"I answered that I could not imagine it otherwise because I had to set an example, and after me others would follow boldly.

"At the end of the meeting Vladimir Il'ich shook hands with me, wished me success in my work and promised assistance.

"All night I was unable to fall asleep from excitement over the meeting with the leader of the proletariat, Vladimir Il'ich Lenin. I walked about my room and thought about the greatness of that man. Our country is torn by war, bread is scarce, coal is scarce, factories are idle, and this man who governs such a great state finds the time to discuss space flight.

"That means that my dream is coming true, I thought."

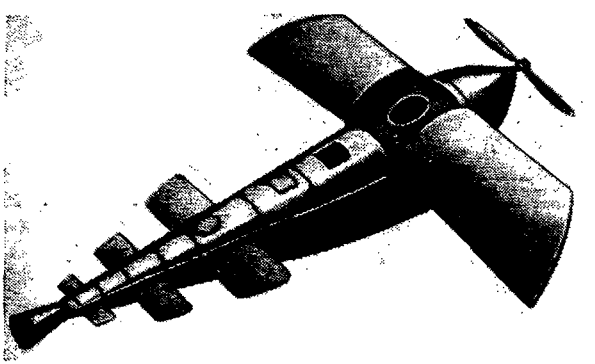


F. A. Tsander.

Lenin's interest inspired F. A. Tsander, and with redoubled energy he plunged into the realization of his projects.

In 1924 F. A. Tsander proposed the design of a spaceship. It was a combination of two planes: a large one, and placed inside it a smaller one. The body of the rocket was common to both planes; the wings, tail unit, engine and propeller of the large plane were made collapsible so that in flights beyond the atmosphere they could be used as fuel.

In 1930 while working at TsAGI* Tsander with the aid of his friends and supporters built and successfully tested the OR-1 rocket engine fueled by gasoline and compressed air. However, the success he attained, far from satisfying the gifted inventor, filled him with strength and faith in his chosen path.



Rocket plane designed by F. A. Tsander.

* [TsAGI — Tsentral'nyi aerogidrodinamicheskii institut (Central Aerohydrodynamics Institute).]

Tsander designed a new engine and designated it OR-2. Unlike the previous engine, this one worked on gasoline and liquid oxygen. Bench tests began in March 1933 and the engine gave good results, developing a thrust of 50 kg.

Tsander's work concerning the theory of jet engines and their design practice played a major role in the foundation and development of Soviet rocket engineering.

The Soviet people duly appreciated the merit of this scientist. Today his name is known to every rocketeer in the army, and to everybody in any way connected with rocketry. In February 1964 the Moscow Municipality decided to name a street in Ostankino after this outstanding scientist and inventor.

The rocket enthusiasts Professor Vladimir Petrovich Vetchinkin and Yu. V. Kondratyuk, a gifted self-taught inventor, made many valuable contributions to rocket science.

Vetchinkin, an outstanding Soviet scientist, and the foremost authority on aerodynamics, in his works "Dinamika poletov" (Dynamics of Flight) and "Dinamika samoleta" (Aircraft Dynamics) elucidated for the first time the theory of the main problems of curved and nonuniform aircraft motion on the earth, near the earth and high in the air, and above all, it was he who as early as the 1930's elaborated the theory of jet aircraft flight.

Yu. V. Kondratyuk was the first to propose the exceptionally promising idea of using liquid ozone, a more efficient oxidizer than oxygen, in rocket engines.

The government's solicitude for the scientists and engineers working in the field of rocket engineering and its interest in their achievements, together with the high degree of planning and organization of the scientific and research work bore good fruit. Soviet rocket science developed rapidly and outstripped the West.

Rocket engineering attracted special attention from military specialists, who, during the Civil War, while the young republic was still fighting for its life, took steps to create for the Red Army a new and formidable weapon capable of defending the people's power against imperialist intervention.

As early as 1920 the first Soviet rockets, produced under incredibly difficult conditions by people completely dedicated to their work, were tested in Petrograd at the Central Artillery Firing Range. This is what happened.

The building of the Central Artillery Range lay under a thick blanket of snow; in one of the rooms a dim light was burning. Bending over the table, leafing through books and looking at drawings and blueprints, was Vladimir Andreevich Artem'ev, head of the weapons laboratory. Stiff with cold and now and again breathing on his hands he was trying hard to solve a problem that had been on his mind for a long time: Why is it that one or two rockets fly normally and that others explode on being launched or while in the air?

This question dogged the inquisitive man day and night. However many calculations he made, however many different modifications he tried, yet the desired solution eluded him.

Eventually, when looking through a magnifying glass at a solid-fuel (powder) charge similar to those used as fuel to fire rockets, Artem'ev noticed that the surface was crisscrossed by minute cracks. "Here is

the cause of all our failures;" he told himself, "now all our troubles and difficulties will be over."

Artem'ev, who devoted all his energy to his beloved work, had shortly before met the engineer Nikolai Ivanovich Tikhomirov, the rocket designer, in Moscow, and together with him and other assistants he began to work tenaciously on the problem of producing the right powder needed for rockets.

Retorts, flasks and chemicals appeared in the laboratory. Long and determined work began, requiring patience, determination, knowledge, and persistence. Version after version was tried but the result was always the same: the rockets would not fly in the way expected by the experimenters.

After four years of searching and experimenting, Artem'ev withdrew a small cylinder from a special mold, two and a half centimeters high, having a hole through it. This, finally, was the solid fuel which satisfied all the requirements of the inventors. Yet it took another four years, until 3 March 1928, on a rough, gray morning, before the rocket enthusiasts could for the first time enjoy the result of their work. Their rocket was tested at the artillery range near Leningrad.

A group of people assembled on a snow-covered field. They all looked impatiently and with obvious curiosity at the small silvery rocket resting on a handmade launcher. Artem'ev, as the head of the project and chief designer, made a final check to see if everything was in order and then ordered all those present to take cover.

The command "Launch!" was given. A blinding flash, clouds of fumes. A fiery trail streaked across the gray sky.

The trial of the jet-propelled projectile actuated by trotyl-pyroxylin powder was completely satisfactory. Rising high into the air, the rocket came back to earth 1300 meters from the place of launching. Endless celebrations followed. Everybody congratulated Artem'ev and Tikhomirov on their great success. This was the first great success achieved by military specialists working in the field of rocket engineering.

However, individual scientists, engineers and inventors, though organized in small groups, could not solve the problems of rocket engineering on a scale required by the Soviet Union. It became absolutely necessary to found an institution with well-equipped laboratories and a special experimental base. And such institutions were founded. First there was the GDL,* developed in 1928 from V. A. Artem'ev's group, and in 1932 in Moscow the Central Committee of Osoviakhim founded GIRD.** In these groups were concentrated the efforts of many gifted Soviet engineers whose enthusiastic work over many years played a major part in the further development of Soviet rocketry: The Soviet government followed the work of these organizations with great interest. Special attention to work proceeding in rocket engineering was given by G. K. Ordzhonikidze and the then Head of Ordnance of the Red Army, M. N. Tukhachevskii.

As could be expected the members of the newly founded groups at first encountered great difficulties in their work. Lack of experience, especially regarding the design and construction of liquid-fuel rockets,

* [GDL – Gazodinamicheskaya laboratoriya (Gas Dynamics Laboratory).]

** [GIRD – Gruppa izucheniya reaktivnogo dvizheniya (Jet Propulsion Study Group).]

meant that the enthusiasts were suddenly faced with a variety of problems. These often had to be solved empirically and by experiment.

Especially interesting and indeed heroic was the work of the members of GIRD, who devoted much strength, ingenuity and creativity to the construction of a liquid-fuel rocket. Having become obsessed with space flight, they did not heed time, health or difficulties which they encountered at every step. If a problem troubled them, they would work for days, foregoing food, sleep and rest, just to achieve their object. But the GIRD people were not alone. They found many valuable assistants, outstanding advisers and other collaborators.

The scientific work of GIRD in a new field, which to many seemed fantastic, found willing help on the part of many famous Soviet scientists. The GIRD workers together with other inventors working on rockets at that time received assistance, support and valuable advice from professors B. S. Stechkin, B. M. Zemskii, A. V. Kvasnikov, K. A. Putilov, N. A. Rynin, K. L. Baev, F. P. Frankl', and many others. This friendly support by famous scientists, giving a helping hand in developing a new technology, was extremely valuable and contributed considerably to the first successes and effectiveness of the activities of GIRD. It reinforced their belief in their work and lent them strength, and thereby had a positive effect on the development of Soviet rocket engineering.

View of the GIRD-X rocket.

The members of GIRD had a long and hard way before them. They had to expend much work and energy and to display much ingenuity and inventiveness before the first Soviet liquid-fuel rocket, designed and built by them, received its "marching orders into life."

The design of the rocket was ready at the beginning of 1933. According to the calculations of the designers, its takeoff weight was to be 19 kg, of which the rocket structure should constitute 8 kg. The length of the rocket was to be 2500 mm, its diameter 180 mm, and the engine thrust about 52 kg with a duration of 15 seconds. But this was only the design. There remained much work to translate the creative ideas into an actual structure. However, this did not frighten the devoted team; on the contrary, it gave them strength and confidence.

The GIRD team went ahead enthusiastically, first building, and then testing their brainchild.

Of course, although this was a good team, not everything they did was immediately successful. Many a time they were confronted with various failures: at one time the engines did not work; on another occasion they went up in flames; then the tanks did not stand up to the pressure and burst; the valves did not work. But the enormous energy of the team, great patience and undaunted faith in their ultimate success eventually triumphed.

On 3 August 1933 the members of GIRD made the final tests with the rocket engine designated 09 by them. The tests yielded very good results. The engine started smoothly, worked well during the allotted time, and

developed the planned thrust. It was decided to install it in the rocket which at that time was also practically ready.

And so came the morning of 17 August 1933. The day for which the GIRD members had been waiting so impatiently turned out to be warm and sunny. Everybody arrived at the meeting place long before the appointed time.

Once more everything was thoroughly checked and the readiness of the rocket for the test was confirmed.

All that was necessary for the test was loaded on a truck with great care and everybody went to the long familiar "rocket launching site." That was the name the GIRD people gave a small field next to a wood situated near the town.

Several minutes of concerted effort, and the rocket was ready for launching. Deadly silence reigned. Everybody looked with bated breath in one direction at the gleaming rocket, a lovely sight, standing ready a few paces away. A few minutes passed, and then the command rang out:

"Take cover!"

The watches counted off the last seconds. And another command:

"Contact!"

At that moment the researchers witnessed what they had been waiting for for years. A bright flame flashed from the engine and the rocket rose, slowly at first, as if unwilling to leave, then it quickly soared upward, leaving a trail of dense smoke and fire behind. What an exciting spectacle that was! How ardent was the joy of the GIRD people! But the pages of the report on the experiment, yellowed with age, do not contain an account of this enthusiasm. The report only states in a matter-of-fact manner:

"The launching took place on 17 August 1933 at 1900 hours.

"During the flight the engine functioned normally. The rocket rose to a height of several hundred meters, tilted and returned to the ground. During the fall the mantle crumpled and a connecting valve broke. The change from vertical rise to horizontal flight and the subsequent return to the ground were caused by the gases piercing (burning through) one flange, in consequence of which a lateral force arose which also "overturned" the rocket."

As soon as the rocket returned to the ground, all the people who took part in the test hurried to the spot where it had fallen. It did not take long to find the cause why the rocket had not reached the height as calculated, and this did not dampen the joyous feeling of victory, for this operational defect was not one that would be difficult to rectify. Every face expressed joy and the GIRD workers were now firmly convinced that the rocket could and must ascend to the height for which it was designed and built.

Not only for GIRD was the successful test of the "09"-rocket a joyous occasion. Together with them celebrated the scientists who had helped them, working people who had fulfilled orders for the production of some parts for the rocket, and other people who had been informed about their work. All this was an encouragement for the gifted team and gave it new strength. And the GIRD members took upon themselves even bolder tasks and prepared to solve even more complicated problems.

During the comparatively few years that GIRD existed, in the midst of this small but enthusiastic and energetic team many interesting scientific ideas were born and put into practice, and a number of very bold designs were realized.

It was mainly by the persistent and inspired work of this group that the foundations of Soviet rocket engineering were laid.

However, as mentioned before, the GIRD people were not alone. Independently of them during those same years a group of scientists formed somewhat earlier worked successfully on building rocket engines; this group consisted mostly of military specialists connected with the GDL in Leningrad. Staunch and strenuous work in this new and interesting field yielded here positive results too. As early as 1930 the first Soviet rocket engine, working on liquid fuel and liquid oxidizer, was developed there. This engine, designated ORM-1 by the inventors, was built in 1931 and soon went successfully through its firing tests, developing a thrust of 20 kg.

The first head of the Leningrad GDL was the well-known engineer and designer N. I. Tikhomirov who, together with V. A. Artem'ev and his colleagues, as early as 1920 had begun experimental work on rocket weapons. In this post he was succeeded by Boris Sergeevich Petropavlovskii, a military engineer no less qualified but even more obsessed with the idea of rocket engineering.

He was a charming and sincere man of powerful physique, an excellent athlete and untiring worker. Although he appeared to be somewhat phlegmatic, when the situation required he became uncommonly energetic and enthusiastic, and had the gift of being able to inspire others.

He never withdrew in the face of difficulties; he himself was not discouraged by failures and he knew how to sustain the faith of others. He had an amazing and rare ability to distinguish quickly and clearly between important and secondary matters, and in the most difficult technical problems to find new and most promising ways of solving the questions arising. One can truly say that Boris Sergeevich Petropavlovskii was loved by his subordinates, they saw in him not only their chief but a sensitive and attentive friend, willing to help with any difficulty.

Petropavlovskii was unreservedly dedicated to his work to which he devoted his life, and he was a tireless propagandist on behalf of rocket development.

As early as 1931-1932 he understood better than anybody else and more than once emphasized the enormous importance of rockets as armaments carried by planes and motor-vehicle launchers. He himself and the team led by him worked predominantly on designing new types of weapons for the Red Army.

At the end of 1930 Petropavlovskii's group constructed a missile of 82-mm caliber (later 132-mm) for arming aircraft, and research on an antitank rocket weapon was begun. Regardless of his preoccupation with scientific work and his administrative duties, Boris Sergeevich attended personally when new weapons were tested. Here is one such example.

Early in the morning a large group of scientists, engineers, technicians and representatives of the army command drove to one of the artillery firing ranges outside Leningrad. The deserted area received the experimenters inhospitably. A biting wind blew in their faces; under its impact the stunted underbrush wavered from side to side, its leaves rustling. Among it are the rusty rails of the narrow-gage railroad. Starting at the center of the plain, the rails ran along toward the dark woods and disappeared behind its edge. All those present at the range took

up their positions as indicated by Petropavlovskii in a special fortified shelter. Looking somewhere into the distance, they awaited the test, tense and silent. Suddenly from behind the wood came a P-5 reconnaissance plane. It flew very low, which made it seem to be flying very fast. This made all the assembled spectators watch attentively. It was easy to read in everybody's eyes the question: "What next?"

Unexpectedly, flashes of light flared up under the wings of the plane. Then dark smoky trails quickly moved from the plane toward the horizon. Another second or two passed and then dark-brown fountains thrown up by explosions mushroomed.

Immediately B.S. Petropavlovskii stepped into his role and explained:

"Comrades! You are watching the explosions of 82-mm missiles. They were fired at previously designated targets from a reconnaissance plane. The same missiles can be used as armament of fighters and light bombers or against airborne targets. However, I want to tell you that this is only the beginning. In the near future we are going to equip our aircraft with even more formidable weapons. Our staff has already developed a 132-mm missile..." Petropavlovskii proceeded to give a detailed description of what this missile could do, as if its advantages had already been proved.

Before the impact of the first test had worn off, the head of GDL announced to the spectators that another weapon was in action.

Several army officers, among them M. N. Tukhachevskii, took cover in a specially fortified observation shelter, and looked through the periscopes provided for them. On the command of the man in charge of the test several expert technicians chosen from the staff brought into action a new weapon, and from tubes fixed to light tripods not far away, a tongue of flames emerged. The fiery missile streaked toward a captured tank standing at a distance of half a kilometer from the shelter. A blinding flash from the explosion on the armor ...

And Petropavlovskii explained again.

"This," he said, "was an antitank weapon in action. It is very light and mobile and can prove to be a menacing weapon in an actual battle. To reduce the weight, the body and the launching tube are made of Duralumin and the new antitank weapon therefore weighs only a few kilograms. An aircraft missile is fired from a rifle. The rifle can be fired from the shoulder or from any other support by one man. In present-day combat with tanks predominating it may prove to be invaluable."

The rocket-propelled antitank rifle produced by Petropavlovskii's staff was proof of the high level of inventiveness of our scientists and inventors. It must be admitted that its armor-piercing power at that time was comparatively small. But at that time hollow-charge missiles which nowadays are used for antitank fire from similar rifles had not then been developed.

In fact that was the reason for which this very advanced device was not accepted as a weapon. But the credit for being the first to construct this type of weapon belongs to the Soviet Union. Not until ten years later, during the Second World War, did "bazookas" appear in the USA, and the "Ofenrohre," "Panzerschreck" and "Faustpatronen" in Germany; they were, in reality, further developments of the innovations pioneered by Soviet designers.

Thus, step by step, Soviet scientists and engineers, inspired by the attention and care of the Party and the Soviet authorities, won ever new successes with their indefatigable work, and constantly enriched rocket engineering by their remarkable discoveries and inventions, giving the Soviet Union the lead in this important field.

The Soviet people could not remain indifferent toward the exploits of rocket engineering which aroused widespread interest and were duly appreciated. The work of the scientists and designers in the field of rocket engineering was publicized in the press, and at public meetings and lectures. Whereas previously rockets had been regarded by many people as something fantastic, remote and belonging to the distant future, the attitude of the public toward rockets now suddenly changed, and they were accepted as something belonging to and part of everyday life. The Red Army command had always been interested in rockets, but now the interest of geophysical, meteorological, medical and other institutions was also aroused.

Scientists greatly needed to investigate the density and temperature of the atmosphere, the intensity of solar and cosmic radiation, the concentration of charged particles, and also to carry out a number of medical, biological and other experiments, all of which could only be realized by means of rockets able to rise high into the atmosphere and carry the instruments needed to provide the data required. Such rockets were called meteorological. In the USSR the first meteorological rocket was successfully launched in 1933. At present meteorological rockets are being launched in the Soviet Union and other countries regularly, and they are the most effective means of studying the upper layers of the atmosphere.

Priority would certainly have been given to the peaceful uses of the first Soviet rockets, had it not been for the hostile activity of the imperialists. Surrounded on all sides by capitalist states, the Soviet Union had to look to its defenses. The Red Army command, realizing the power of rocket weapons, made great efforts to introduce rocket weapons into all branches of the armed forces.

To speed up the development of rockets, the government decided in 1933 to combine the work of the rocket designers of GDL in Leningrad and the members of GIRD in Moscow. The Scientific Rocket Research Institute was established and staffed by scientists, engineers, and technicians, who had at their disposal the best equipment available. As first head of the institute Ivan Terent'evich Kleimenov, a great enthusiast of rocket engineering, was appointed. On his initiative the staff of the institute cooperated closely with Konstantin Eduardovich Tsiolkovskii and was constantly guided in its work by his immortal ideas on rocket engineering.

Well-equipped laboratories, an excellent experimental base, the united efforts of many Soviet scientists and engineers, all yielded positive results. Soon the institute was constructing new types of rockets and testing them, first on the ground and then in the air.

Everything the institute constructed was new and unusual, and as with everything that is new, many difficulties had to be faced. There was, for example, the work connected with studying aircraft rockets. After numerous experiments on the use of aircraft missiles in the conditions of the scientific research institute, the army command decided on broadly

based studies under battle conditions. Accordingly, scientists, designers, and other specialists went to the south of the Soviet Union in 1937.

At an airfield there all the technical facilities were carefully prepared and all personnel assembled and fully briefed. As soon as everything was ready and conditions met the stipulations of the commission in charge, work began.

At first everything went well. The airmen testing the new weapons skillfully attacked their targets, quickly hit the "enemy," and demonstrated the efficiency of rockets against aerial targets, especially bombers flying in close formation. The new weapon worked faultlessly. It was a considerable improvement over the previous equipment. This caused the designers indescribable joy and filled the airmen with pride because they had received a powerful weapon for the fight against the enemy. It seemed that there was no cause for worry and anxiety. All that was necessary was to organize as quickly as possible the rearming of the air force and thus to secure a considerable increase of its firing power. However, this exultation did not last long. Soon disenchantment set in.

When in late autumn of that year the aircraft equipped with the new weapons were sent to Moscow for shooting practice, something unexpected happened: the missiles, which had been tested so many times in the south and had proved their worth there, "refused" to fly. Some fell as soon as they had been launched; others, although they flew, failed to reach their targets.

"Where is the trouble?" asked engineers Yurii Aleksandrovich Pobedonostsev and Fedor Nikolaevich Poida, racking their brains. "How can such a failure be explained?" And again strenuous work began. Again research, experiments and investigations began; sleepless nights and days crammed with work followed. The cause of the trouble was eventually found to lie in the air temperature. In the south it had been warm and dry. Near Moscow the temperature often dropped below zero. Once the cause of the trouble was found, it was not difficult to eliminate it. It did not take the engineers long to attain the desired results. They only reduced the nozzle diameter by a few millimeters and the rocket missiles worked without a hitch in any weather.

But, as a popular saying has it, it never rains but pours. Scarcely had one problem been solved when another arose.

"Jammed again, Yurii Aleksandrovich," the technician Pavlenko reported to engineer Pobedonostsev.

To the engineer himself it had been more than obvious that the design of the launching equipment, with four guide rails between which the missile moved, was a failure. With such a mechanism it was impossible to guarantee that it would work normally. There was always the danger of bending or jamming.

"Sasha, how about doing it like this?" Pobedonostsev quickly sketched on a piece of paper the version he had had in mind for a long time, a guide in the form of an I-beam, on whose lower half the missile slid along, held by two grips.

"That is something!", the technician said jubilantly.

. The engineer's idea suited Pavlenko. Without procrastination, he immediately produced the blueprints. And after a few days a new and lighter launcher appeared. Tests proved its advantages over the old

type. There was no more jamming; the missiles left the launcher smoothly, without trouble.

But there is no limit to ingenuity. Ivan Isidorovich Gvai, another engineer, continued work in improving the mechanism and found an even better solution: he designed a light guide in the form of a T-shaped beam. The new device worked even more accurately; its shape was reminiscent of a flute, and it was therefore not surprising that I. I. Gvai's launcher received this romantic name. Later on this design found widespread application. It was mounted in all planes and later also in multiple ground launchers.

Thus the gifted team of rocket inventors in 1937 on the whole ended its work on the design of missiles for the air force. Much that was new appeared at that time in aircraft engineering. Scientists and designers endeavored especially to build a rocket-carrying aircraft of great speed and high ceiling. Many teams of designers worked hard to develop the special engine that was needed for this.

The first original design of an air-breathing jet engine with centrifugal compressor, gas turbine and combustion chamber, working at constant pressure, was submitted in 1923-1924 by the Soviet engineer V. I. Bazarov. His design was original in its concept and contained all the main elements of engines of similar type which were built almost two decades later in the Soviet Union and abroad. It is only fair to note that even today the concept first pioneered by Bazarov still forms the basis of such contemporary engines.

Western inventors arrived at this solution, so important for the development of aviation, much later. It was 13 years later that engineer Whittle applied for a patent of a jet engine similar to Bazarov's. Of course, this did not prevent the mercenary capitalist press from giving Whittle all the publicity, and they even tried to claim precedence over the Russian invention. But facts are stubborn. The story of Whittle's priority, as could have been expected, was short-lived. Nowadays it is generally accepted that the credit for designing the first jet engine belongs to the Russian inventor, the Soviet engineer V. I. Bazarov.

One of the first Soviet rockets being prepared for launching.

In the Soviet Union a turbojet engine with axial compressor and annular combustion chamber was designed as early as 1937, considerably earlier than abroad. The author of this exceptional project was the famous engineer and designer A. M. Lyul'ka.

In the early thirties the development of a ramjet engine was undertaken. The solution of this problem was attempted by the designer I. A. Merkulov. Together with a team of workers of the jet section of the stratosphere committee of Osoviakhim he built prototypes of ramjet engines. Then followed wind tunnel tests of the rocket and

the engine. On the night of 19 May 1939 the official flight tests of the ramjet engine began. The tests were carried out at night because in flight the gases emerging from the engine could be better observed against the background of the dark sky.

Eyewitness reports show that the flight of the rocket propelled by a ramjet engine was successful. The results of the tests were recorded in a document which is quoted below. Our present terminology was not used in literature at that time; ramjet engines were referred to in the report simply as "air-rocket engines", and the rocket itself as a "wingless torpedo".

OFFICIAL REPORT OF THE TEST OF THE AIR-ROCKET ENGINE

"On 19 May 1939, in ... a test was carried out of the air-rocket engine designed by I. A. Merkulov.

"The subject of the test was a wingless torpedo with an air-rocket engine.

"The fuel for the engine was made in the Institute of Chemical Technology im. Mendeleev. For launching the torpedo an ordinary solid-fuel rocket was used.

"The combustible mixture and the solid-fuel rocket were ignited by an electric primer, powered by an accumulator. Between the combustible mixture and the electric ignition a fuse was inserted to delay the ignition of the mixture by one second against the solid-fuel rocket. The ceiling of the torpedo and the flight velocity were determined by a team of astronomers.

"For launching into the air the torpedo was mounted on a launching pad.

"Launching was carried out at 2240 hours. The test of the torpedo led to the following results:

"The torpedo rose vertically from the launching pad. Owing to the prearranged braking effect of the air the solid-fuel rocket separated from the torpedo after one second and dropped to the ground. At that moment the air-rocket engine began to work. From the exhaust nozzle of the engine a stream of incandescent combustion products went vertically downward. The engine worked evenly and without interruption. The duration of rocket engine operation, corresponding to the quantity of available fuel, was 5.5 seconds. When the engine began firing the flying speed increased markedly. During the entire duration of the engine operation the torpedo rose with increasing speed. After all the fuel had been used up, the rocket continued in its flight by inertia. The entire flight was steady and strictly vertical.

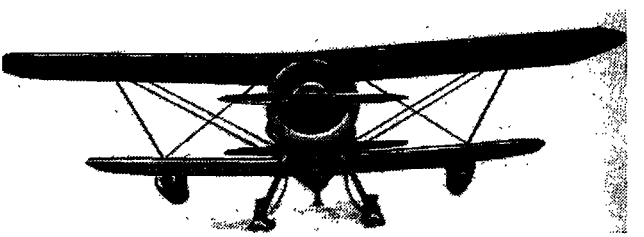
"This flight by the rocket fully confirmed the reliability of the air-rocket engine and the increase in flying speed of the rocket powered by this engine."

During the years that followed such engines were improved, subjected to tests and introduced in the aircraft industry.

In 1939-1940 the first flight tests of air-breathing jet engines were carried out. They were installed in aircraft as boosters to increase flying speed.

The first flight tests of ramjet engines mounted in aircraft were carried out by P. E. Loginov. On 25 January 1940, the aviator and inventor Loginov took off in an I-15 plane with two ramjet engines mounted under the wings as boosters. Gaining sufficient height, he switched on the ramjet engines. Those watching the flight from the ground saw tongues of fire leaping from the rear of the plane. The pilot, wishing to test the performance of the engine under the most extreme conditions, then opened the throttle excessively, but even so the engines worked without a hitch. The observers only noticed that the fiery tongues behind the aircraft became longer.

The findings of the commission testing the flight of the I-15 plane with ramjet engine was as follows: "On the basis of the flight tests the commission finds that the plant has produced an air-breathing jet engine which works in the aircraft and increases its flying speed."



I-15B aircraft with ramjet engines mounted under the wings.

Particularly valuable work in constructing rockets and jet engines for aircraft was done during the Second World War and in the postwar years. Soviet scientists, engineers and technicians attained astounding successes in the design and improvement of turbojet engines.

During the Second World War reliable gas turbines and subsequently also aircraft jet engines were developed. In the forefront of those successfully solving the very difficult problems involved were the Soviet designers A. A. Mikulin, V. Ya. Klimov, A. M. Lyul'ka and others.

The Soviet scientists, engineers and technicians united as they were by K. E. Tsiolkovskii into a single school, and having the advantage of being provided by their country with excellent conditions for their creative work, advanced rocket science very rapidly within two decades, and made huge strides in the development of jet engines. What had seemed a short time before an unattainable dream, was put into practice in actual fulfilled projects, and became reality. In 1939 the armed forces received several types of missiles which were subsequently used not only in the air force, but also by the ground forces and even on some naval vessels.

Thus Soviet scientists and inventors within a short time brought about a tremendous advance in rocket engineering.

Our rocketeers proved to be worthy heirs of their predecessors in whose footsteps they followed and whose work they continued. True to tradition, they spared neither strength nor labor to further develop and perfect the heritage of technical skills and rocket techniques handed down to them.

THE BIRTH OF THE ROCKET CARRIERS

The first rocket salvoes fired in war came from rocket-carrying planes. This was in 1939 on the banks of the river Halhain Gol.

In the summer of 1939 the Japanese army made a perfidious attack on the Mongolian People's Republic. The object of this armed provocation was to gain an operationally advantageous area of concentration. The Soviet army, in conjunction with forces of the Mongolian People's Revolutionary Army, defeated the aggressors decisively on the Halhain Gol, thereby strengthening the position of the Soviet Union in the east.

Certainly this operation could not be considered large in terms of the war of 1941-45, but even in 1939 planes, tanks, and armored cars were used effectively on a large scale. It was particularly here on the Halhain Gol, that the Japanese imperialists experienced the might and power of Soviet rockets.

This is what eyewitnesses who took part in the fights said about the events of these days.

In the sultry Mongolian skies over the river Halhain Gol dogfights broke out sporadically between Soviet and Japanese planes. The Soviet fliers firmly held the initiative throughout. In almost every aerial fight, Japanese planes were shot down, and then fell to the ground in a black "mourning ribbon" of smoke. Between 24 and 27 August alone, the Soviet pilots downed 74 enemy planes, and between 28 and 31 August the Soviet air force destroyed 45 Japanese fighters and four bombers.

On one such day the Japanese staff received a report that during an aerial fight the Imperial air force had been fired on by antiaircraft guns. However, according to their previous intelligence reports, there was no antiaircraft artillery in the area involved, and the Japanese became uneasy. They decided to investigate.

A single-engine reconnaissance biplane took off from one of the Manchurian airfields soon afterward. Its crew had the task of determining whether there were Soviet antiaircraft guns in the area concerned. The plane did not return to its base. The Japanese sent another reconnaissance plane. This one was more fortunate. It succeeded in fulfilling its mission. The aerial photographs as well as the airmen's reports pointed to the same conclusion: there were no antiaircraft guns.

"Who, then, shot at the aircraft?", wondered the Japanese staff officers, glumly racking their brains without success. It was only a few days later that an accident occurred which helped the enemy to make some slight progress toward solving the mystery of the inexplicable phenomenon. A Japanese airman who took part in the dogfight and by a miracle saved himself in his stricken plane reported to the air-force command: "There were flashes of fire on the wings of the Russian planes, and there were fiery trails in the air."

Specialists summoned from Japan who investigated the damaged fighter, came to the following conclusion: "The damage was caused by artillery shells of approximately 76 mm caliber."

However, the military engineers working in the field of aircraft armaments in Tokyo were extremely skeptical as to whether it was possible to mount guns of such caliber in aircraft. They put forward instead the widest assortment of guesses and assumptions, most of which, however, pointed to the same conclusion, namely that the Soviet communists had put into operation a completely new weapon such as had never before been used.

Their conclusion was absolutely correct. The Soviet command tested the ability and power of the new weapon which had previously been tested only in laboratories and on firing ranges. Now, for the first time in history, a new and powerful weapon — rockets — was used in air battles. Altogether, a group of five fighters armed with rockets went into action in Mongolia. The group was commanded by the 27-year-old airman and researcher Nikolai Ivanovich Zvonarev. This is what preceeded that historic event.

In the middle of summer 1939 at a railroad siding near the town of Chita huge crates were unloaded from railroad trucks and platform cars.

N. I. Zvonarev.

Soon some military specialists there organized the assembly of fighter planes. The work was headed by Military Engineer 2nd Class A. D. Popovich and Military Technician 2nd Class A. G. Gubin, who arrived at the siding together with the pilot Zvonarev from Moscow. Every assembled plane was provided with rocket arms by the technicians. The I-16 fighter planes received eight 82-mm missiles, four under each wing, in addition to their existing armament of "shkas" machine guns. The work proceeded in an organized manner with friendly co-operation. Every soldier fulfilled his duties accurately and quickly. Popovich was in charge of all the work. He did his stint alongside his comrades whom he helped with advice and by his direct participation, and he took an active interest in every detail. How could it have been otherwise? Who knew better than he how much effort and work had been expended by Soviet scientists and engineers to build the new weapon.

He himself had worked for almost five years on research connected with aircraft rockets. At the firing ranges he often met V. A. Artem'ev, a slight, gaunt man in army fatigues, without distinctions, taciturn, who had contributed greatly toward the development of rocket engineering. Popovich also knew that as early as 1920 Artem'ev, together with

Tikhomirov, had experimented in Petrograd with rockets propelled by black powder.

The engineer knew well about the enormous contribution made toward this work by the famous engineers and inventors B. S. Petropavlovskii, G. E. Langemak, L. E. Shvarts, and others.

Popovich was often reminded of the tests of the 82-mm missiles for bombers which had been carried out at the end of 1937 and in which he had taken part. At these tests he often met the engineers Yu. A. Pobedonostsev and F. N. Poida who worked on problems of rocket ballistics. There he also saw I. I. Gvai who was in charge of building airborne launchers. With all this in mind, how could Popovich remain indifferent toward his work? It fell to him to incorporate the fruits of almost twenty years of creative effort by a large team of people.

Popovich was anxious and tense and assailed by many doubts: "How will the new weapon turn out? Will everything be in order?" Eventually all his anxieties and doubts were dispelled. The day of the test had come.

At 0545 hours on the morning of 20 August, while our infantry, cavalry and tanks got ready for a decisive attack in the region of the river Halhain Gol, the Soviet artillery and air force dealt the positions of the Japanese forces a crushing blow.

On that day Zvonarev, and the airmen under his command assembled at their planes long before dawn and impatiently awaited the command to take off. Formations of nine fast Soviet bombers, with fighter planes providing cover for them, streaked across the azure sky.

However, the order to take off did not come. It was not given until the day was almost over, at 1657 hours. The five fighters armed with rockets were led by Nikolai Ivanovich Zvonarev. Behind him, keeping exactly in formation, flew First Lieutenant Pimenov, Lieutenants Fedosov, Mikhailenko and Tkachenko. The first rocket carriers were protected from above by "Chaikas." Left and right of them were I-16s. These aces of the 22nd Aviation Regiment guarded the carriers of the new weapon with great care. After flying for five or six minutes, the pilots first saw under the wings of their machines the sandy hills on the right bank of the Halhain Gol, pitted by shells and smoking after air and artillery attacks, and afterward they saw much evidence of the stubborn fighting on the ground.

Zvonarev was on the alert. Each pilot began carefully scanning the horizon. Somehwere in the distance to the right, between the blurs that were the lakes Uzur-Nur and Yen-Hu, the commander of the flight spotted some flitting points. The experienced pilot assumed that these were Japanese fighters. One, two, three minutes passed, and he thought for a moment that he had been mistaken. There were about forty of them. They were flying in several formations at a height of about 3000-3500 m. When the adversaries were about a kilometer away, Zvonarev fired a rocket salvo. At his order the other fighters also launched their rockets against the enemy.

The Japanese pilots who had not expected to be fired at from such a distance were stunned. Avoiding a fight, they dispersed and turned tail. The Soviet fliers decided not to pursue the enemy, and they returned to their base.

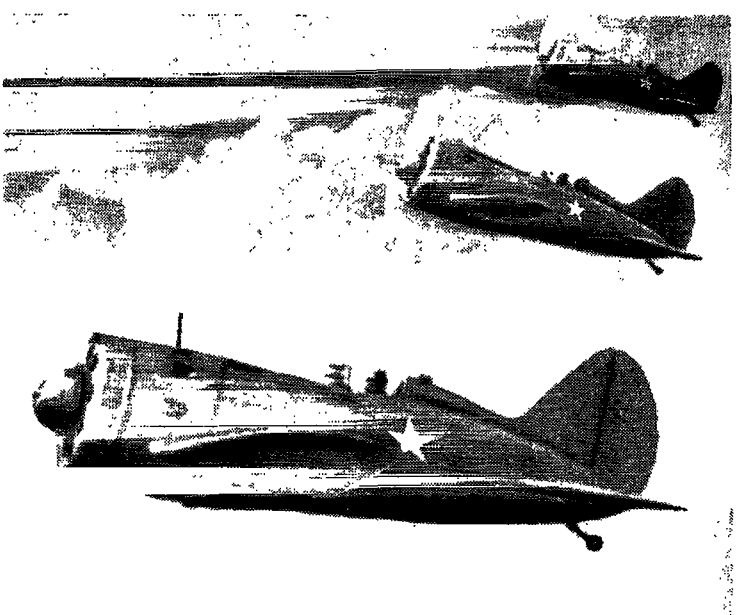
Soon after having landed, Zvonarev was called to the telephone.

"Congratulations on the first success, Nikolai!" the well-known voice of the regimental commander, Hero of the Soviet Union G. P. Kravchenko, issued from the instrument. "On the ground there are two destroyed Japanese '97s'. You are credited with them. Nobody fired from the ground."

Zvonarev immediately informed his fellow pilots and the ground crews of the good news. Everyone was deeply moved by the first victory of the rocket weapon. Thus for the first time in history two planes were destroyed by rockets in an aerial fight.

On the second day of the offensive, 21 August, the enemy, having been harassed the evening before and having suffered considerable losses, tried several times to alleviate the pressure of the Soviet forces. For this purpose he exploited all the means at his disposal, relying especially on his air force. But the intentions of the Japanese command were not fated to be realized. The planes bearing the red star adequately dealt with the enemy and prevented his escape. The five rocket carriers took an active part in these actions.

According to the flight schedule, Zvonarev led his group on a sortie in the morning. As always, "Chaikas" protected them. Flying over Hamar-Daba, Zvonarev saw explosions erupting all around the light ribbon of the river Halhain Gol. "It is obvious," the flier decided, "that the Japanese are trying to destroy our crossings; we must prevent them from doing that!"



I-16 planes in flight — the first Soviet rocket carriers.

Zvonarev informed his comrades of his decision, and the group went in to attack. The commander's fighter plane veered to the left and streaked toward the enemy. Immediately, as if moved by invisible strings, the maneuver of the lead plane was repeated by the other four: Pimenov, Fedosov, Mikhailenko and Tkachenko. Behind them, but just as fast, followed the protecting planes.

The maneuver of the Soviet fliers did not escape the notice of the Japanese. They cut their mission short and hurried back to their territory.

"No," shouted Zvonarev, "you will not get away!", and he lifted the throttle lever as far as it would go. Obeying the skilled aviator, the fighter plane shot forward. The distance to the Japanese bombers slowly diminished; they gradually grew in size.

Zvonarev, his eyes glued to the sight, whispered: "Only 1,200 meters remain, 1,100, 1,000, 900, 800 meters. Now!" His hand pressed the launching knob. The pilot looked around: on the wings of the planes flying abreast of him there were also fiery flashes. Explosions, marked by black clouds, took place amidst the formation of the enemy planes. Two Japanese bombers crashed to the ground, leaving behind them a black and red trail of smoke and fire.

Several hours passed after this fight, and the fighters armed with rockets and attached to the 22nd Regiment again took to the air. This time they encountered a large group of Japanese 97-type fighter planes. In the ensuing fight the Soviet pilots skillfully employed the new weapon and shot down several aerial pirates.

The group of rocket carriers which fought at the river Halhain Gol participated later in many more battles, and they were victorious every time. Among the enemy losses there were always planes shot down by rockets.

Thus for the first time in the world the Soviet air-to-air rockets underwent their baptism of fire. It was the fate of one of the aggressors to experience their power personally. The use of rockets in the fighting did not remain a secret. Soon the Soviet rockets were talked about not only in the East, but also in the West.

The first rocket salvoes thundering above the river Halhain Gol indicated that in the Soviet army a new class of specialists had appeared — the rocketeers. The Soviet people became very familiar with the names of the first heroes of the air who proved the great power of the rocket weapons, not on firing ranges and in laboratories, but directly in battle with the insidious enemy. These airmen were Zvonarev, Pimenov, Fedosov, Mikhailenko, and Tkachenko. Since then a long time has passed but their names and achievements have not been forgotten by the people. They are well-known not only in units of rocket-carrying planes but in every rocket unit, regardless of which branch.

The successful employment of rocket weapons against the Japanese air force convincingly proved their superiority over conventional armament. They were consequently introduced in air-force units and were again used successfully in the war against the White Finns. At that time 82- and 132-mm solid-fuel missiles were effectively employed by airmen not only against aerial targets, but also against those on the ground.

Admittedly, rockets were not yet the accepted armament of all air-force units by June 1941 for various reasons. However, unlike the other

branches of the armed forces, the men of the air force were already familiar with rockets from the very beginning of the war with the German fascist invaders. Applying their fighting experience gained at the river Halhain Gol and in the battles against the White Finns, the Soviet aviators used their skill to deal the fascist invaders heavy blows with this weapon from the very first day of the war. This is what one of the participants in the battle for Moscow said about the incipient employment of rocket weapons:

"... I remember standing in the ranks. On the right stood the airmen; we, the air force specialists, were on the left. Next to me was the instrument fitter Volkhonskii; also present was the mechanic Gladkikh. I stood there and listened attentively to Pilyugin, the commander of the squadron.

"'There is much work ahead,' he said. 'In a few days we are going to receive rocket weapons.'

"Everyone was happy about this news. What excitement — my neighbors were thrilled; they dug their elbows into my side and winked. Although it was forbidden to talk while on parade, how could one remain quiet?

"The commander permitted questions, and the men in the ranks asked and remarked:

" 'When are we getting them?'

" 'What kind of rockets are they?'

" 'They will be useful against the fascists!

"The squadron commander saw to it that the curiosity of the members of his unit was satisfied. He spoke in detail about the missiles, about the plans for quickly rearming the regiment, and about the dates fixed by the command for learning to handle this weapon.

" 'And thus the fascists will feel our growing strength in the near future,' the commander said in concluding his address.

"Soon the moment arrived. The command decided to attack a fascist airfield with a large aerial force which included rocket carriers. It was a sullen day. Hovering above the ground were gray clouds, thick as if of cotton. There was occasional rain. Visibility was not more than 3 to 5 kilometers.

"The enemy did not expect an attack in such weather, which was almost impossible for flying. However, as a precaution he kept a few Messerschmitt Me-109s ready to take off.

"When the first Soviet planes appeared above the airfield, the Messerschmitts rolled down the runway, but they were immediately hit by fire from the supporting planes. The air reverberated with mighty booms. From the low altitude at which they had to fly because of the clouds, the Heinkels, Messerschmitts, Junkers, and other enemy planes were clearly visible. The chief purpose of the attack was to destroy most of the fascist bombers.

"Every Soviet airman had a specific fighting task. Those who belonged to the covering group had to concentrate all their fire on enemy antiaircraft weapons. The two striking groups were to go for the aircraft on the ground.

"And then the daring attack on the airfield began. The first to reach the target was a squadron of MIGs. After having fired a few salvoes at the Soviet planes, the fascist AA gunners had the wind knocked out of them. The fire from the sky proved to be stronger than the fire from the ground.

Then came the rocket salvoes. A terrible hurricane burst from under the wings of the Soviet steel birds, and enveloped the enemy AA gunners in black caps of searing explosions.

"The planes belonging to the striking groups also joined in the fight. The planes bearing red stars swooped down to where the planes marked with crosses stood. Fiery trails streaked toward their engines, wings, and fuselages.

"The fury of the attack increased every second. What happened on the ground defies description. Where the rockets scored, parts of enemy aircraft rose into the air. The entire field was strewn with smoking wrecks. Then stronger explosions followed. The bombers, blown up by their own bombs, were afire.

"And the attack continued. Amidst all this, the machine guns added their rapid tattoo. With terrible screeching the missiles found their objectives. Rocket salvoes followed one after the other.

"In the beginning of the attack the fascists endeavored to put up some kind of defense in order to save their aircraft from the deadly fire; they also attempted to attack by means of some disjointed gun and small-arms fire, but later on they broke down completely. Some of them found their death among the debris of their aircraft; others fell victim to the fire from Soviet aircraft. Those who were lucky enough to survive, tried to escape as far as possible from this harrowing nightmare.

"According to reconnaissance, the result of the attack was that up to thirty fascist planes were destroyed and about twenty damaged. The Nazis lost tens of airmen, killed and wounded. The enemy airfield was out of action for more than twenty days."

No less successful in the use of rockets were the Soviet airmen when they met the enemy in the air. This is well-illustrated by the following episode.

Once a VNOS* post reported enemy reconnaissance planes approaching Moscow. An orderly rushed into the dugout where the airmen waited in readiness:

"Odinokov and Shishkin to their planes!"

Grabbing their gear, the airmen ran to the connecting trenches. No more than a minute passed, and the two fighter planes were flying toward the enemy.

For Odinokov the flight was particularly troublesome. The opponent proved to be experienced. Spotting the approaching fighter from afar, he changed course sharply, and losing height, he attempted to evade his pursuer at top speed.

"I thought," Odinokov later related, "that the reconnaissance pilot had already given up his intention of getting through to Moscow and was retreating in the opposite direction. But that was only a ruse. As soon as he had gotten away from me he again set course for Moscow.

"At that I literally boiled over. No, I thought, you are not getting through. Your bones will yet rot in the earth before you reach Moscow. And putting on maximum speed, I soon caught up with the enemy bomber. At first I fired a few rounds from my cannon at it. The enemy aircraft wavered slightly but proceeded to fly in the same direction. And again it

* [VNOS — Vozdushnoe nablyudenie, opoveshchenie i svyaz' (Aircraft Warning Service).]

began to escape by losing height. It was now hardly possible to hit it with gunfire. I decided to use the missiles.

"I launched the first one. A few seconds passed and a black cloud of the explosion appeared to the right and in front of the enemy aircraft. I had missed the target: the enemy was untouched. Then I launched the second missile with a correction I had quickly worked out in my head. The missile exploded directly above the cabin of the air pirate. The aircraft wavered from side to side and dived to the ground."

Such employment of missiles was certainly justified. Soon their use became widespread. Airmen returning from assignments told how they used the first missile to determine the range, and the second and subsequent ones to destroy the enemy.

Days passed. The forces were steeled by the fighting. The country sent more and more units to the front, armed with the most up-to-date weapons. The number of air force units equipped with rocket carriers also increased.

The extensive use of rockets by the Soviet air force had already begun in the battle for the Soviet capital, Moscow. In the beginning the aviators did not always use the rockets to best advantage, especially against ground targets, but at the end of 1941 they handled this weapon expertly.

The first heroes appeared who in the fighting demonstrated their excellent training and superb skill in the use of rockets. One of them was Ivan Golubin who distinguished himself in the battles against the German fascist invaders. Here is one episode from his wartime exploits.

In the middle of December 1941, when the enemy began to retreat under pressure of the Soviet forces, the pilot Ivan Golubin was ordered by his commander to take off in a westerly direction. His task was to attack an enemy column moving along the Dorokhovo-Mozhaisk highway. He reached his object quickly and attacked. One blow followed the other. Fires raged on the road; the fascists were seized with panic, but the experienced airman kept his head. He carefully observed the situation in the air all around him, and his efforts were not in vain. Coming out of a diving attack, the pilot noticed that a dozen Messerschmitts headed for the place of the attack. It was already impossible to avoid an aerial battle. It was, however, at variance with the plans of the courageous airman. Showing exceptional skill, endurance, and presence of mind, the Soviet ace shot down two enemy planes, and strafing afterward, he flew toward his airfield. However, he had not covered even half of the distance when he encountered five enemy bombers. They emerged completely unexpectedly from the clouds, flying straight at him.

Instantly weighing his fighting chances, Ivan Golubin arrived at an unpleasant conclusion: "There is hardly any ammunition left. But as long as there is even one missile, it is necessary to hit the fascist serpents."

The Soviet airman boldly attacked a Junkers. For better accuracy, he approached dangerously close. When it seemed that the planes were about to collide, he launched the last remaining missile and quickly banked. The audacious maneuver prevented a collision, but the fascist bomber quickly lost height and crashed into the ground, leaving behind a trail of black smoke.

The airmen of the Moscow zone of the antiaircraft defense exhibited much skill, resourcefulness, and inventiveness in aerial battles. Their many unrivaled exploits caused the fascist invaders to tremble.

The fascists thought that night air raids on the Soviet capital would be less risky. They began their attempt to break through to Moscow at night. Under cover of complete darkness they had previously managed to reach the objects as planned. But this did not last long. The Soviet airmen received help from searchlights. Every night the sky above the capital was lit up by bright blue beams. If a searchlight caught an enemy plane, it held it, and a Soviet fighter, on alert in the vicinity, attacked the illuminated enemy plane. Several rounds of machine-gun or cannon fire and the vaunted Nazi ace, burning brightly, dived straight into the ground.

However, it was not always like that. It happened that a Soviet plane got into the searchlight beam. Then its dazzled pilot had to abandon the attack. This happened most frequently when the Soviet plane, intent on fighting the enemy, headed straight for him. The cannon, and the machine gun even more so, was unsuitable for attacking the enemy at long range. To be sure of accurate firing, a short distance had to be attained. The situation proved to be difficult, but a solution was found — missiles were employed. The distance at which a missile can be launched is twice as great as the distance required for cannon or machine-gun fire. With the greater firing range the probability of shooting down the plane caught in the searchlight beam was much smaller. The efficiency of the Soviet planes increased greatly. There was a better chance of defeating the fascist aerial pirates.

This is how the pilot Vasilii Kochin described a night battle in the air:

"Our I-16 encountered a He-111 at night. The plane was caught by a searchlight beam. The enemy was visible but it was impossible to approach him without also being dazzled.

"The airman fired several rounds with his cannon. Nothing happened — he was too far away. Then he decided to use his missiles. In the dark it could be clearly seen how our missiles detached themselves from the plane, flew away, and burst. The first salvo damaged the enemy plane. After the second salvo it caught fire, banked, and lost height. Finally it dived into the ground and blew up in a nearby wood."

Especially successful were the rockets fitted in the [Ilyushin] Il-2 assault planes. With the aid of these rockets the assault planes destroyed tanks and other targets on the battlefield. The Hitlerite soldiers called the Soviet assault planes "Black death," especially because of the powerful rocket salvoes.

During the war years every soldier managed to witness a powerful attack by Soviet assault planes. An attack by these faithful "drudges of the battlefield" could only be compared to a hurricane of fire. After an air raid by Ilyushins on enemy-occupied territory only charred and destroyed weapons remained and a few soldiers who had managed to find a safe shelter in time.

The pilot of an assault plane, twice Hero of the Soviet Union A. K. Nedbailo, was particularly skillful in employing rockets.

This happened at the Third Belorussian Front. Under the powerful blows of the Soviet forces the fascists retreated quickly to the west. The air force supported the ground forces, destroyed fleeing columns of enemy motor transport and units at the station in Gorodziki, and helped finish off an encircled enemy force 12 to 15 kilometers east of Minsk.

On 8 July 1949, Nedbailo, who has been mentioned before, and his squadron started for an assault on the crossing of the river Svisloch'.

The country beneath the planes was clearly visible. At the approaches to the stipulated area, at a road between two green mountain ranges, a long-drawn-out column of enemy forces appeared. At the river Svisloch', on a wide plain free of woods, confusion reigned: in front of the narrow crossing various military vehicles crowded around like a flock of sheep.

The assault planes turned and entered the attack from the right. The target was hit. The planes began to circle and to attack various parts of the enemy concentration on the plain and near the road. A hail of bullets and shells rained down on the invaders.

Then came the rockets. Like fiery flares they emerged from under the wings of the planes and beat down on various enemy groupings.

A similar picture could be found on all fronts of the war. Assault planes without rockets were as unthinkable as bombers without bombs.

The new weapon pleased the airmen. They were always glad to use it in a fight, and that they often emerged victorious could justifiably be attributed to it.

In the air-force units armed with rockets a good rule was established: aircraft carrying rockets were first entrusted to pilots who had proved in fights with the German fascist invaders to be skillful, tenacious, and courageous soldiers. This rule was adopted at first out of sheer necessity of consigning the new weapon to those who could utilize it most effectively, and that could be done only by the most experienced and courageous airmen. Later this necessity became a tradition. To receive a plane armed with missiles became a great honor for an airman — a testimony to his high skill and outstanding courage. But this also carried great obligations. Every crew that had been honored by being enabled to fight the enemy with the new weapon considered it its duty to show exemplary skill, boldness, and courage.

Another good tradition became the passing on of experience in the skillful utilization of the new weapon in the fight for the homeland. Under the difficult wartime conditions in flight squadrons and regiments the fighting skill of the crews was steadily being improved. The most experienced airmen considered it their prime duty to teach their young colleagues all there was to know about contemporary aerial fighting — the ins and outs of the use of rockets against adversaries in the air and on the ground. This made it possible to successfully solve the problem of immediately replacing the inevitable losses by fully competent airmen.

Emphasizing the advantages of Soviet equipment over that of the enemy played a large role in educating the Soviet airmen, and in imbuing them with a feeling of great responsibility for the fate of the homeland. At meetings with airmen, the commanders and political workers proved conclusively the advantages of rockets in aerial fights with an adversary

armed with machine guns and cannon. At the same time the paramount importance of combat training of the airmen was always emphasized, their fighting skill being the basis of all Soviet victories.

This tradition, together with the new weapons, caused the hitherto highly-praised Nazi airmen toward the end of 1941 to become extremely careful in fights with Soviet airmen, especially those armed with rockets. The enemy greatly feared our assault planes which caused the fascist invaders innumerable losses with their bombs and rockets.

In the heavy fighting of the Second World War the Soviet airmen proved themselves to be worthy defenders of the socialist homeland. Right at the beginning of the war the whole country knew of some of their exploits, and the air-force units that distinguished themselves most by their fighting achievements, organization, discipline, and order were transformed into Guards units. Among them were also units armed with rockets.

Many officers and generals of our famous air force, having shown courage and boldness in the fighting against Hitlerite Germany and imperialist Japan, still serve in this branch. They are the living bearers of the traditions, who, with determination, pass on to the personnel the best of what has accumulated over the years in air-force units and formations. Many of them were among those to whom the homeland first entrusted rocket-carrying planes more than twenty years ago. They have much to tell their comrades-in-arms who are learning to handle such planes

"KATYUSHA'S" FIRST WORDS

No less famous is the history of the Soviet ground-to-ground rockets. It may be safely said that their beginnings are the same as those of the rockets used as armaments of planes.

At the time that work was in progress on the design, production, and testing of air-to-air rockets, military engineers and technicians in laboratories and firing ranges were busy preparing rockets for ground-based multiple-rocket launchers. This idea was voiced as early as 1933 by B. S. Petropavlovskii and G. E. Langemak who worked on rocket weapons for aircraft. However, at first this idea was not fated to become a material force. Petropavlovskii soon died and Langemak met a tragic end, having been slandered in 1937. However, by the middle of 1938, thanks to the persistence of the staff of the Scientific Research Institute of Rockets, work began on a ground-based multiple-rocket launcher intended for 24 missiles of 132-mm caliber. It was mounted on a truck chassis. The results of tests on the firing range were good, but there were also a number of serious shortcomings. Another year passed during which the staff of the institute was engaged in arduous work, and in the summer of 1939 the first six experimental launchers of the new ground-to-ground rocket weapon were ready.

The last version of the ground-to-ground rocket launcher was different from its predecessors. It could only accommodate 16 missiles but it could be fired along the axis of the truck. Loading of the launcher was more convenient — there was a "breech part." This last version was also the one on which the BM-13 fighting vehicles were based which during the Second World War gained enormous fame under the name "Katyushas."

The final tests of the completed machines were made on the eve of the Second World War, on 21 June 1941. The ground rocket launchers were viewed by the leaders of the Communist Party, the Soviet government, and the Red Army command. The new weapon received the highest praise. On that same day the government made a special decision concerning the mass production of ground-to-ground rocket launchers and the accompanying missiles.

The Moscow plant "Kompressor" received a large order for this type of weapon. Naturally, no one at the plant had the slightest idea what the launcher was for. The engineers and technicians were only informed about the technical side of the matter. That the order was complicated and unusual did not deter the staff which was well-known for its high technical competence.

In the meantime it was found that the production of rocket launchers encountered great difficulties. Much trouble was caused particularly by what was called at the plant the "guide channels" — the same excellent

"rails" that gave the "Katyushas" their characteristic appearance. The foremen and workers, who had been used to making refrigeration equipment, had to learn new production methods on the job which they had not needed before, such as machining heavy five-meter-long components, setting up guides with great accuracy, and mounting heavy structures on the chassis of three-axled trucks.

Moreover, one section of the department in which compressor parts were then being made, had to launch the production of M-13 rockets within a short time.

The beginning of the war speeded up the production. Within a few days the staff of the "Kompressor" plant, in accordance with the government decision, produced the first batch of BM-13 vehicles for these rockets which formed the first rocket battery in the world; it had a short but heroic history. These are some of its highlights.

On the night of 2 July 1941, a column of automobiles drove at high speed through the blacked-out and deserted streets of Moscow. The few passers-by, who had recently become accustomed to seeing troop movements at night, did not pay much attention. The trucks forming the convoy were not particularly conspicuous either. Some of them were loaded with crates containing missiles; others carried army stocks neatly stacked and covered. Only the first five trucks were different. Under their new army tarpaulins there was a load of unusual shape. The trucks were different from the others too — they had three axles.

Thus the first rocket battery in the world moved to the front having been assembled in the camps of the Moscow Artillery school. This battery was under the command of Captain Ivan Andreevich Flerov, a student at the Artillery Academy im. F. E. Dzerzhinskii, a man of great endurance and experience, who commanded artillery units in the fighting against the White Finns, and was decorated with the Order of the Red Star.

I. A. Flerov, the commander of the first battery of "Katyushas."

He had become battery commander quite unexpectedly. As a student at the academy, Flerov, like his comrades, was taking exams at the end of the term. All his energy was absorbed by that task, and he had no time to realize that he had been singled out from among his classmates and was to be entrusted with such a responsible task.

On 28 June Captain Flerov was urgently summoned to the office of the course commander and ordered to put himself immediately at the disposal of the Staff of the

Commander of the Red Army Artillery. There he was already expected, and was immediately conducted to the office of General V. V. Aborenkov. The general was alone, and everything seemed to indicate that he had also been waiting for Captain Flerov. He quickly stepped forward to meet the officer, as he entered, received his report, and said:

"Great confidence has been shown in you. Just now the order nominating you commander of the first special battery of rocket artillery in the Red Army has been signed. Are you acquainted with this type of weapon?"

"No, Comrade General. This is the first I hear of it."

"Do not let that worry you. I tell you frankly, like any newly issued device it is simple in design and extremely easy to handle. But you will be the first commander in the world to handle such a weapon. In your hands will be concentrated firing power of gigantic dimensions previously unimagined. It is therefore necessary to become well-acquainted with the new weapon quickly, and then to use it skillfully in combat. You will receive the weapons and their ammunition today and you will immediately start forming the batteries.

"I am giving you very little time for forming the batteries — all in all a few days. But do not worry. In organizational matters you will have the assistance of Lieutenant Colonel Krivoshapov, and for the technical side there are the representatives of the industry. They will go together with you to the front to lead the battery into the fight."

The general walked about his office, deep in thought; then he went to the captain, and looking him steadily in the eye, continued:

"Listen carefully, Comrade Flerov, and always remember this: a weapon is being entrusted to you which constitutes a military and state top secret. I warn you: under no conditions must the enemy receive any knowledge concerning this weapon. In case the situation becomes desperate, the weapons and their ammunition must be blown up." Lost in thought for a moment, the general continued: "With the forming of your battery a yet unwritten page of the history of a new branch of service is being opened; it has a great future. Your task is to write the first glorious deeds on this page."

The general got up and shook Captain Flerov's hand firmly:

"I wish you great success."

The captain turned about briskly, and with firm steps left the office. In his head one thought chased the other. Even yesterday he had had no idea that he would be charged with such a responsible task. He had not intended to hide away within the walls of the academy while the country entered into a bloody war, but that he would suddenly receive such a task — no, that had never entered his mind.

That same day Captain Flerov, together with Lt. Col. Krivoshapov and the representatives of the industry, left for the camp of the artillery school near Moscow to tackle the work. Within a short time he had to create a military unit the likes of which had never before existed.

Experience accumulated over the years, the commander's high organizational ability, and extensive and skilled assistance from the representatives of the Red Army Artillery Staff as well as from industry, all helped to accomplish the work. Within four days the battery had been formed. A few days later the unit, having acquired skill in the use of

their powerful weapon, went to the front. On 14 July, Lt. Col. Krivoshapov and Captain Flerov reported their arrival to General G. S. Kariofilli and immediately received a combat task from him.

"The order is to attack the railroad junction of Orsha which is clogged with enemy units, and to be ready for possible salvoes on the crossings which the enemy is constructing on the Dnieper and the Orshitsa," the general said brusquely. He quickly spread a map on the grass and showed with the butt end of a pencil the places where the crossings were made.

"The battery is ready for the given combat task, Comrade General. The task is clear. May we begin?", Captain Flerov replied crisply.

"Very well. Get to work. I believe that your mission will be successful," General Kariofilli replied, and dismissed the artillerymen.

After having returned to the battery, Flerov and Krivoshapov gave the order to prepare the weapons for immediate use, and they themselves went to the observation post. After a few minutes five camouflaged trucks, could be seen moving toward the edge of the wood at short successive intervals. Their bodies had been replaced by rails whose front ends protruded above their cabs. At the other end of the rails one could see the metallic brilliance of fairly long objects whose shape was more reminiscent of aircraft bombs than of shells.

A. I. Krivoshapov (1941).

Slowly, in order not to raise dust, the trucks lined up and assumed firing positions.

At that time the battery commander calculated the firing data, and together with Lt. Col. Krivoshapov he checked them repeatedly. He was very much concerned that even the first salvo of the battery should prove accurate and effective.

"Battery ready for combat," reported the senior officer by telephone from the firing position of the battery to the captain.

"I point out," Captain Flerov said, turning to Lt. Col. Krivoshapov, "that the first rocket battery of artillery in the world is about to open fire on the 14 July 1941, at 1515 hours."

And into the telephone he immediately gave the order:

"Fire salvo!"

One moment passed. Then a deafening roar, unlike anything known, reminiscent of thunder, rent the air. Huge black-brown puffs of smoke and dust rose high in the air. It seemed as if the earth itself reared up. Preceding the fiery trails were about a hundred missiles. Their movement

could easily be followed even by the naked eye. Behind every missile there was at first a clearly visible wake of fire and later a whitish-gray vortex of gases which quickly dissolved into the air.

For several seconds everything froze and became still. Even the exchange of fire at the forward positions abated. Another moment and the earth groaned under the impact of heavy explosions. At the Orsha railroad junction a terrific roar and blinding flashes heralded the almost simultaneous explosion of tens of thermite rockets. They crashed into the midst of hundreds of assembled railroad trucks, destroying soldiers, weapons, ammunition, fuel — everything the enemy had managed to concentrate in this important center of communications. Only a few minutes passed and the station was enveloped in a roaring blaze.

Most of the Hitlerite soldiers and officers were killed outright, and those who miraculously survived, rushed about frantically among burning transport trains, choking in the fumes and the heat. Some of them were eventually killed by their own ammunition which began exploding in the fire; others burned to death in the blazing and exploding tank cars carrying fuel. The few who managed to come out of this caldron alive were completely stunned for some time.

Salvo of mine throwers of the Guards.

The fire, sometimes abating, then starting up again with renewed force, lasted for almost three days. It finished what the rockets had not achieved immediately; it destroyed an enormous amount of weapons, ammunition, and fuel. The enemy suffered considerable damage.

Thus thundered the first salvoes of rocket artillery in the world. This was the combat baptism of the world's first rocket battery — the first page of the noteworthy history of rocket artillery.

Pleased with the results of the first salvo, Captain Flerov turned to Lt. Col. Krivoshapov and said:

"It seems we are justified in informing the Commander of Artillery and the Supreme Command that the engineers and workers have produced a splendid weapon! We can assume that the repercussions of the panic, which today seized the Hitlerites, will reach as far as Berlin."

"They certainly will," Krivoshapov replied, "and not only to Berlin. Soon the whole world will talk about this. But bear in mind that the fascists will now organize daily hunts after your battery; they will do everything in their power to capture it, if possible, and if not, then to destroy it. Prepare yourself for this possibility and explain it clearly to the entire personnel. Ah!— the hunt for the battery has already begun: take a look at what is going on at the firing posts."

Recovering from the terrible blow and seen pinpointing the position of that incredible weapon used by the Russians, the Hitlerites first subjected them to massed artillery bombardment and then several bombing raids from the air. One after the other, groups of enemy bombers flew past, showering high-explosive and fragmentation bombs on the place where a few minutes before the rocket launchers had stood. But it was already too late. The soldiers of the battery, in response to their commander's orders, had succeeded in hiding the trucks in a nearby wood.

Having successfully fulfilled the first task, the battery soon prepared for the second one. The battery commander reconnoitered the target well, skillfully chose the firing position, accurately calculated the firing data, and with a crushing salvo hit another large group of enemy forces.

The fascists did not expect that blow. A continuous stream of tanks, cars, and trucks with troops, ammunition and fuel converged on the crossing over the river Orshitsa. The infantry also marched. Part of these forces had already succeeded in crossing over to the eastern bank and in occupying a small bridgehead; another part was just crossing. However, the main body was still on the west bank awaiting its turn. It was especially here that our rocket artillery directed its devastating fire. Like the first time, the battery fired all its launchers simultaneously. Tens of rockets exploded on the crossing and on the banks of the river. Tanks and trucks loaded with ammunition and gasoline went up in flames. The bridge was blown to pieces. Weapons and vehicles fell into the water from destroyed pontoons. The surviving Hitlerites were seized by unimaginable panic. Tanks and trucks which had not been knocked out endeavored to escape from the fiery ring, squashing each other and destroying that which had escaped the fire from the rockets.

Our command made use of the favorable situation and attacked the fascists who had been crossing over to the east bank of the river. A large group of fascist soldiers and officers stopped all resistance and surrendered.

The Hitlerites marched dejectedly, guarded by our soldiers. Having themselves experienced the crushing force of the new Soviet weapons, they were stunned by fear, and it took them a long time to recover. It was quite some time until at last one of them, asked by our officer how he liked the attack of the Soviet artillery, replied:

"Oh! Colossal! That was a nightmare..."

Panic did not only seize the Hitlerite soldiers in the area of the crossing, but even those at a fairly large distance from it. They all fled in fear, throwing away weapons and abandoning armaments, not comprehending

what was happening. They were convinced that hundreds of Russian guns had fired simultaneously.

The battery did not stay long at that place. One task more complicated than the other forced Flerov's men to change frequently not only their firing position but even the sector of the front. As a rule the battery appeared where things seemed to be going badly.

On Saturday, 9 August 1941, the rocketeers arrived at the El'nya area. There a force under the command of General Sobinnikov was defending itself. The town had already been taken by the fascists, and judging from the numerous fires, it was easy to guess that they had already instituted their "new order." Tired from the heavy fighting, the Soviet soldiers and commanders improved their defense and dug in deeper and deeper. Everyone had only one modest wish: to have a short rest!

Among the tired soldiers an unknown slender commander suddenly appeared. He was clearly distinguishable from the sun-burned and dust-covered fighters of the command post of the 53rd Rifle Division which defended the line here.

"Captain Flerov, commander of the rocket battery," he reported briskly to the commander of the artillery of the division, Colonel G. Plaskov.

The commander, interrupting a conversation with his subordinates, turned to Flerov, took a paper from the captain, and read it quickly.

"Well, I am glad to welcome the officer in charge of a new type of weapon. I hope you will help us at this difficult moment."

"Please acquaint me with the task," the captain replied.

Colonel Plaskov, a prudent, powerful man of medium height, known among artillerymen as an expert, was quiet for a little while, and then said:

"Tell me, captain, what is your battery able to do?"

Flerov told him what the combat qualities of the new weapon were, and how the unit had fought at Orsha and Smolensk, and he invited the artillery commander to view the combat vehicles.

The experienced artilleryman quickly grasped the principle of the simple weapon, and he was soon to be convinced by practical experience of the power of the rocket weapons.

As could have been expected, the fascists, having brought up their rear, prepared to advance further. The enemy planned the attack for early morning, counting on catching the Soviet forces unaware. But they miscalculated. They were about to concentrate on the line from which they intended to advance when fiery comets shot across the sky with a deafening roar. After a moment everything was quiet. It seemed as if nature itself had withdrawn and was waiting. What would happen?

Colonel Plaskov had his eyes glued to the telestereoscope. In front of him, four kilometers from the command post, there was a shattering view. At the place where the enemy was massing for the attack, not only tanks and vehicles were burning — the very earth was smoldering. From that moment on the telephone at the observation post rang incessantly. Everyone wanted to know what had happened.

"The heart was filled with joy and pride in the homeland, in the creators of the new powerful weapon, the modest pioneers of the first battery of Guards mine throwers in the Red Army." That was how the the retired Lieutenant General of Artillery Plaskov described his feelings

at the time. "I should have liked to congratulate my comrades-in-arms — to share my joy with them. But a secret is a secret. Suppressing my feelings, I had to reply to my friends: 'I do not know anything. Probably the sappers are up to something.'"

Everyone celebrated, but Flerov's men did not get dizzy from victory. They knew from experience that only a few minutes would pass and the Hitlerites would attempt to crush the battery. The rocketeers therefore, after having fired a salvo, quickly hid in a wood which they had chosen beforehand. And they were right: as soon as they had vacated the firing position, it came under long-range artillery fire of the enemy.

As could have been expected, the strong and effective fire of the Soviet rocket artillery alarmed the Hitlerite command. This was confirmed not only by what the fascist soldiers along the entire Soviet-German front said, but even by the self-confident commanders at the German Supreme Command. It can also be inferred from the uneasy orders and directives which were quickly passed down the entire chain of command.

This is what an order of the German High Command of 14 August 1941 contained: "The Russians have an automatic and multiple flame-throwing gun... It is fired electrically. At the moment of firing fumes form... If such guns are captured, it will be reported immediately."

Exactly a fortnight later the German command sent another directive to the units, concerning "Russian weapon launching rocketlike missiles," which said that "...the forces report the use of a new Russian weapon firing rocket-propelled missiles. One launcher can fire a large number of shots during 3 to 5 seconds... Whenever such weapons are spotted, a report is to be submitted the same day to the general at the Army High Command responsible for smokescreen units."

The successful actions of the mine throwers of the Guards, as the rocket launchers were later called, threw the German-fascist invaders into confusion. Soldiers and officers of the Hitlerite army spread by word of mouth legends of the destructive effects of the new Russian weapon which they called the Russian "church organ." The fascist command was forced to take urgent measures in order to stop such talk. Soldiers and officers were punished for spreading information that Soviet "organs" were active nearby, as heavily as if they had spread defeatist rumors.

The Soviet forces were heartened by putting into action the rocket artillery which in its path swept the fascist invaders before it. They followed the exploits of the "Katyushas" with great pride and created all the necessary conditions for utilizing this dread weapon as profitably as possible.

Both sides followed the "Katyushas." The fascists organized a veritable hunt for the "elusive infernal machines." They showered the Soviet defense positions not only with bombs and shells, but also with leaflets in which they promised all sorts of rewards for those who would help them capture even a single launcher. The Soviet command was well-aware of this. When the rocket battery was sent to some section of the front, an order to guard the secret of the special weapon followed immediately.

Colonel Plaskov also received such an order. Subordinating Captain Flerov's battery to his immediate command, the commander of the artillery of the 43rd Army, General Taranovich, requested that everything

be done to utilize the battery as much as possible, and to guard it carefully from the enemy. To that end he advised that a special chart of cooperation be prepared on which should be marked all the squares ahead of the Soviet forces, and the initial data for firing at these squares should be prepared in advance. This would make it possible to open fire on any part of the enemy-occupied positions when necessary quickly and without the risk of betraying the position of the battery. Flerov's men, proceeding in this manner, never failed to fulfill the task before them.

In the fighting for El'nya our artillery regiment commanded by Lt. Col. Frantsev found itself in a difficult position. Having advanced to fire at enemy tanks, we were practically cut off from the other forces when the Germans mounted a counterattack. It was necessary to extend immediate help to our comrades who had run into trouble.

The divisional commander sent a reserve company of infantrymen in motor cars to relieve the artillerymen. But what about artillery support for the attack? Conventional artillery cannot be moved at a moment's notice, and there is no time to lose. The solution lay with Captain Flerov's battery. A short telephone conversation ensued. The squares of the coded map were named and the time of the rocket attack fixed. Exactly at the appointed time Flerov's men unleashed a hail of devastating fire on the fascists.

Several tanks caught fire, and the enemy infantry, advancing on the positions of the artillery, scattered in panic. The Soviet infantry company went in to attack. With bayonets and hand grenades it finished off the enemy. The artillerymen, taking advantage of a favorable moment, removed their weapons to new firing positions. It was an unforgettable sight how they thanked the soldiers and commanders of Captain Flerov's battery for their powerful assistance.

On the other hand, the enemy was furious. Their failures enraged the Hitlerite invaders. They hunted obstinately for the battery that had caused them so much trouble. To gain their objective they dispatched entire infantry and artillery units and attempted to set traps.

In October 1941 the life of the first rocket battery in the world met a tragic end. What happened to Captain Flerov's unit?

In the fighting near El'nya the battery, together with other forces, was encircled. But that did not break the fighting spirit of the Soviet soldiers. Attempting to break out of the fascist ring, the encircled units fought valiantly. The rocket battery also took an active part in these battles. On 4 October it fired at the enemy crossing the river Snopat', causing heavy losses. The commander realized that after the salvo he would not be able to lead the unit out of the encirclement at this sector, so he withdrew the battery toward the rear, to Spas-Demensk. But it was too late: the roads to Spas-Demensk and Yukhnov were swamped with fascist forces.

The battery managed to disengage itself from the enemy. Keeping to back roads, it prepared to move toward Vyazma. But even there it encountered the enemy. After having captured Yukhnov, the Germans advanced to link up with their northern flank, and the encircling ring was complete. The roads of retreat of the Soviet forces in the area of El'nya and Smolensk were cut off.

Escaping from the pursuing enemy, Flerov's men did not lose hope of saving their battery. They attempted to get out of the encirclement by forest paths, but the large quantity of trucks made that maneuver difficult and robbed the unit of its mobility. To reduce the size of the column, Captain Flerov gave orders on 6 October to destroy some supply vehicles. This also made it possible to save precious fuel. The soldiers understood very well the position they were in and they briskly carried out their task, although it was difficult to part from the brand-new vehicles which were in perfect order.

Seeing the dejected faces of his subordinates, Captain Flerov gathered the rocketeers around him and openly explained to them the situation confronting the battery; then he indicated their future course and said:

"We all took an oath to serve the homeland faithfully — we swore that the enemy would not under any circumstance learn about our new weapon. As you know, every one of our launchers can be instantly blown up. This is my order: if the battery finds itself in a completely hopeless situation, the launchers are to be blown up. I will be on the lead truck and will do it first. You must follow me."

Ending his speech, Flerov looked attentively at his comrades-in-arms. The experienced commander saw in every soldier's and officer's eyes a readiness to obey any order given in the name of the homeland.

The men quickly mounted the remaining trucks and the convoy moved off in the direction indicated by Flerov. The battery was well-hidden in a wood.

Before dusk fell it reached the edge of the wood. It was impossible to continue. An open plain stretched ahead of them for 5 to 6 kilometers. In front of them, somewhat away from the road they saw the village of Bogatyr', district of Znamensk, Smolensk Region.

Knowing that the enemy was hunting for the battery, the captain was careful. He selected a reconnaissance group and sent it ahead on a truck. Their task was simple: to cross the field, investigate the wood for about 5 to 8 kilometers, and return to the unit, carefully examining the village of Bogatyr' on the way back to see whether the enemy was hiding there.

They had to wait a long time — for more than an hour.

By the time the scouts returned it was already dark.

"The way is clear; we did not find any German in the wood nor in the village," the man in charge of the scouts reported succinctly.

"Then advance ahead of us at a distance of not more than half a kilometer!" Flerov ordered. "Do not let yourselves be distracted; keep a careful watch! If you spot danger, signal immediately!"

The scouts quickly took up their positions on the truck and moved forward.

A few minutes later the convoy of the battery began to follow the scouts. The trucks drove slowly with their headlights off, in single file, strictly keeping their distance from each other. Captain Flerov drove in the cab of the first launcher, heading the column. With him was the commander of the battery's ambulance service, the military medic Avtonomova.

Despite the scouts sent ahead, Flerov himself scanned the darkness carefully. When the battery was level with the village of Bogatyr', he suddenly saw the silhouettes of people and guns.

"Is it possible that the enemy is here?", he considered, his mind shrinking from the thought. At that very moment the Germans from in front, from the left and from the right let loose a barrage at them from machine guns and cannons at close range. The plain was lit up by enemy rocket flares. In their deadly pale light the members of the battery saw a large enemy trap as clearly as their hand. A considerable force, previously prepared by the enemy, barred the way of the battery. Cunningly permitting the scouts to pass, the fascists planned by means of an unexpected attack from three sides first to stun, and then to kill most of the personnel, and finally to capture the material that interested them so much.

The battery commander understood: the situation was hopeless. The decision was made instantly: to destroy the launchers and to lead the survivors of the battle into the woods. He quickly opened the door of the cabin, pushed Avtonomova out, and told her:

"Break through to the woods!"

He himself ran to the second launcher which was commanded by the Party representative of the battery, Sergeant Nesterov.

One thought recurred in his head: "What would I not give to fire a salvo into the enemy." At that moment he felt a strong blow on his face. Blood ran down his cheek.

Ignoring the searing pain, he shouted to the Party organizer:

"Nesterov, drive the launcher back and fire a salvo at the fascists!"

Then Flerov went back to his vehicle. The commander of the launcher Sergeant Ovsov returned the fire against the Germans.

Flerov took up his position in the cab and, leaning heavily on the steering wheel, got hold of the control handle and turned it. From its launching guide one rocket took off and thundered into the fascists' position. At that moment a huge explosion occurred. The entire launcher, torn into pieces, blew up. Sergeant Ovsov was thrown far to the side by the pressure wave. He lost consciousness.

The blowing up of the first launcher was interpreted by the men as a signal and the last order of their beloved commander. Carrying it out, the launcher crews drove back a short distance and launched their last rockets toward the enemy trap. Then they blew up one launcher after the other.

From all sides the fascists hurled themselves at the surviving group of soldiers. But faithful to their oath, the surviving artillerymen defended themselves with firearms and hand grenades, and in small groups and singly, carrying the wounded, they escaped to the woods.

Until dawn the Hitlerites searched the plain in the hope of finding wounded members of the battery, and they collected every scrap of metal strewn about by the explosions. But their trouble was in vain: the shapeless fragments of the trucks did not enable the enemy to unravel the secret of the new Soviet weapon.

This is how the first battery of rocket artillery of the Soviet Army fought against the enemy. It has recently come to light that after the heavy fighting about fifty members of the battery escaped to the woods. However, they did not succeed in regrouping. Sergeant I. N. Konnov, recovering from a concussion, roamed the woods alone for a long time

until he came across a partisan unit. He joined it and continued fighting Hitler's forces. Some of the rocketeers, after having criss-crossed all over the Smolensk area for many kilometers, reached the positions of their units.

Skillfully utilizing the wooded terrain, and more than once escaping from the enemy, Lieutenant A. V. Kuz'min, Party representative of the battery Sergeant I. Ya. Nesterov, Komsomol [Young Communist League] representative of the battery Sergeant A. A. Zakharov, launcher commander Sergeant I. E. Gavrilov, and the commander of the ambulance service of the battery Yu. V. Avtonomova (now Osokina) led many rocketeers out of the enemy encirclement. Arriving at their units, the soldiers of the battery immediately joined the ranks of the defenders of the homeland and continued to fight the fascist invaders in various sectors of the front.

The homeland has not forgotten the heroic deeds of its glorious sons. The Presidium of the Supreme Soviet of the USSR by a decree of 14 November 1963 decorated Captain Ivan Andreevich Flerov posthumously with the Order of the Patriotic War, Ist Class.

On 19 November 1963 at the Central Museum of the Soviet Army the decoration was handed to the family of the commander of the first battery of rocket artillery. From the hands of Major General of Artillery D. Z. Vorob'ev, the wife of the famous artilleryman, Valentina Trofimovna, and his son received the award.

The battery which Ivan Andreevich Flerov commanded did not fight for a long time, but its memory will live through the ages, for it was particularly this battery that first gave an example of courage and of the skillful employment of the dread weapon in actual combat, blazing the trail toward the high skill which the soldiers of the new units of the rocket artillery have attained.

The great maneuverability and fighting qualities of the rocket launchers were duly appreciated by the Soviet soldiers. The Soviet government lavished much attention on the new weapon; everything was done to supply the Red Army with rocket artillery within the shortest possible time. Thus, the first battery of "Katyushas" was followed by others, and new rocket units kept joining the fighting. At the end of July 1941 the 16th Battery of "Katyushas," commanded by First Lieutenant I. T. Denisenko, made news at the western front. In November and December 1941 in the battle for Moscow hundreds of such fighting vehicles were already taking part. In the middle of November 1942 there were 424 launchers at the Don front alone, and by the beginning of 1943 the number of these vehicles had reached 1,656.

However, "Katyushas" were not the only rocket weapon of the ground forces which the Soviet Army used against the German invaders. After the BM-13 launchers, which fired M-13 missiles, their "older brothers" (as regards caliber) appeared; they were lovingly called "Andryushas" by the people. These heavy 300-mm rocket-propelled mines had a terrific destructive power. No field weapon whatsoever could withstand a direct hit of such a missile. A salvo of a rocket brigade armed with BM-30 (later BM-31) launchers caused terrific damage over a large area, and had a crushing influence on enemy morale.

The appearance on the battlefield of such powerful and mobile weapons as the "Katyushas" and the "Andryushas" was one of the greatest creative

achievements of the designers of Soviet weapons, and was a complete surprise to foreign specialists. Despite various wiles the enemy did not succeed in penetrating the secret of producing that dread weapon until the end of the war, and their attempts to design weapons similar to the famous "Katyushas" failed.

Major General of Artillery D. Z. Vorob'ev hands a decoration to Valentina Trofimovna Flerova, wife of Captain Flerov. Next to her is her son Yurii Ivanovich.

THE ROCKET THUNDER ROARS...

The exploits of the soldiers, sergeants, and officers of Captain Flerov's battery were the first deeds of soldiers of the ground forces armed with rocket weapons. They wrote one of the first pages of the heroic history of rocket artillery. This new type of people had a perfect command of the armament entrusted to them, but they had only just begun to learn its tactical details and its use on the battlefield. They were exceptionally courageous and resourceful, and were inspired by a feeling of responsibility for the task entrusted to them to always fulfill their duty toward the homeland. Their comrades-in-arms continued the work of the pioneers in employing rockets in battle, and in the subsequent years they accomplished many heroic deeds.

As the war continued, more forces joined in the fighting. The excellent new tribe of rocketeers grew constantly. They took an active part in the fighting, and by their resourcefulness, ingenuity, bravery, and courage they surprised friend and foe alike.

The motto of the Guards mine-thrower units which was obeyed throughout the war, and with which they accomplished their deeds in the name of the beloved homeland was: strike where things look particularly bleak, where the situation is most dangerous, where "mother" infantry needs timely and effective help most.

Fame and glory were gained by the colors of the unit commanded by the Hero of the Soviet Union Karsanov. This unit was much talked about a few days after it appeared at the front. Its firing power was enormous, and it always attacked the enemy unexpectedly at the most sensitive sections. The accurate salvoes of this unit disrupted many attacks by the fascists who in autumn 1941 endeavored to break through to Moscow. The most memorable day for this excellent team was 11 November. Not far from Moscow, in Skirmanovo, an inhabited locality, the enemy concentrated a large amount of tanks and infantry. It was clear to everyone that any minute the Germans would strike. The Soviet command decided to foil their plan by launching a powerful attack. Captain Karsanov's unit was charged with administering this blow.

Precisely at the appointed time the rocketeers took up their firing positions. A minute passed, then another, and then, like a swarm of black birds, a flock of missiles streaked toward the enemy. A sea of flames, and clouds of smoke and dust covered the place where the enemy had been.

The Soviet infantry, inspired by the daring exploits of the soldiers of the rocket artillery, went in to attack, and occupied an enemy stronghold. The fire proved to have been very successful. The soldiers found 17 disabled tanks, more than 20 destroyed mortars, and several guns. Everywhere the bodies of enemy soldiers and officers were lying about.

The surviving Hitlerites did not put up any resistance. Many of them had completely lost their reason.

For the soldiers of the unit 22 November was no less memorable. The unit had received another task from the command: as soon as darkness fell they were to move into the Den'kovo area and to support the defending infantry with the fire of its batteries. When the rocketeers arrived in the assigned area, they found that there was no infantry ahead of them. The sector of the front was not covered, and the enemy could at any time move forward unopposed. The rocketeers were not discouraged. They secretly took up positions, built a circular defense around themselves, and for two days they successfully withstood attacks by enemy tanks and infantry from the area of Davydkovo-Grebel'ki. The courageous artillerymen did not abandon the area until ordered by a higher command to do so.

There were other times when the unit took part in the fighting and dealt the enemy, as he was pressing toward Moscow, crushing blows. These are the results of that fighting activity: in November 1941 alone the unit destroyed up to three infantry regiments, about 30 tanks, 200 motor vehicles, and silenced more than ten Hitlerite cannons with blows from its rocket launcher.

A salvo by "Katyushas" at night.

With great enthusiasm Trofim Progorelov told about the heroic deeds of the second rocket unit outside Moscow; he himself had personally taken part in the liberation of the village of Ekaterinovka near the town of Serpukhov.

"Our unit was ordered to occupy an inhabited point at dawn by a swift attack. The commander's question as to whether the attack would be supported by artillery, elicited the reply: 'We will be supported by fire from Captain Korotuk's unit.'

"We had already heard how bravely the artillerymen, the 'Katyushniks', acted at various places, but so far we had not seen them. Now the appointed hour had arrived. In front of our eyes several vehicles emerged at great

speed from a nearby grove, lined up, and fired a salvo at the enemy. The spectacle was overwhelming. A huge area was suddenly covered by a sheet of flame. It appeared as if the enemy blended with the earth and the snow. Arriving after a few minutes at the place where the fire had raged, we found about 300 fascists bodies, many destroyed motor vehicles, cannons, machine guns, and mortars."

The Guards mine throwers also were covered with undying fame in the battle at the Volga. Having already a year's experience in utilizing rocket artillery in combat, the rocketeers inflicted irreparable damage on the enemy. Their actions were now much more sophisticated; they had learned to fire not only from hidden positions, but more and more frequently they emerged to fire point-blank. This represented a new stage in the use of the rocket weapon.

It is no wonder that the mine throwers of the Guards were considered by the higher command to be one of the main assault forces. The Soviet Information Bureau gave almost daily reports of skillful actions, valor, and heroic exploits by the rocketeers. Here are only some of them:

1 October. "At the northwestern outskirts of the town... the Guards mine throwers hit and burned 13 tanks, and destroyed a six-barreled mortar."

3 October. "The mine thrower unit of the Guards commanded by Comrade Dorofeev fired on an enemy concentration, annihilating more than 200 German soldiers and officers."

4 October. "The fire from our mine throwers burned four German tanks, gutted three mortar batteries and destroyed seven dugouts."

8 October. "The Guards mine throwers engaged and annihilated about 400 Nazis, and burned 18 motor vehicles with troops and ammunition."

9 October. "During the day the Guards mine throwers destroyed two German tanks, set 13 motor vehicles on fire, and annihilated about 300 enemy soldiers and officers."

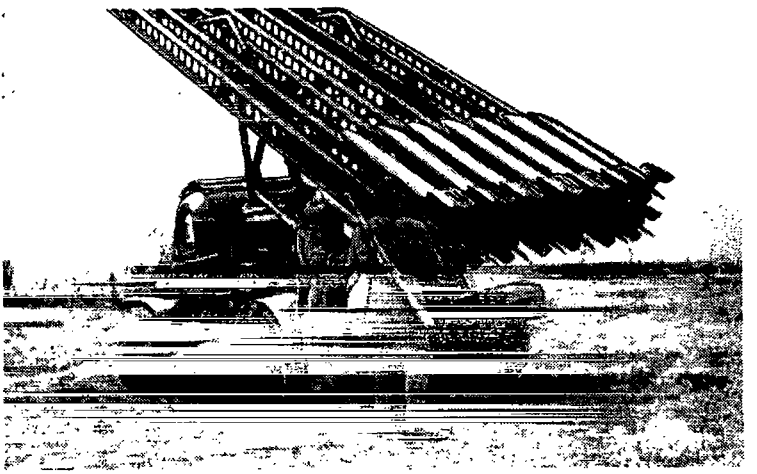
This is how the Soviet Information Bureau officially described the actions of the famous "Katyushas" which, according to calculation by specialists, fired 2,875 salvoes launching 270,000 missiles against the enemy in the period of the battle on the Volga, which lasted from the middle of July until 19 November 1942.

In these battles special fame was reaped by the second battalion of the regiment commanded by Lt. Col. Erokhin.

In street fighting, which often developed into hand-to-hand combat, this battalion fired 30 salvoes daily over a period of twenty days without changing its position. The first battalion of the same regiment repulsed not less than 24 enemy attacks within as short a time as three days of peak fighting. In the battle on the Volga Erokhin's regiment alone destroyed and dispersed several thousand enemy soldiers and officers, destroyed and set afire more than 50 tanks, annihilated more than 160 motor vehicles, and destroyed about 20 artillery and motor batteries.

Every day the forces of the rocket artillery became bolder, and gained strength and experience. They did not become dizzy from the successes they had attained with their weapon. They endeavored to exploit its potentialities even more fully; they courageously took on new tasks and successfully dealt with them. Thus in the beginning of 1943 the targets of the rocket artillery were not only soldiers and weapons of the enemy

but even defense positions fortified in depth. The rocket artillery received better and more powerful missiles, and achieved outstanding results in breaching the fortified enemy belts.



Loading the M-13 launcher (1943).

An excellent example of skillful application of rocket artillery fire in breaching previously prepared defense positions was the destruction of the focus of enemy resistance in Tolkachevo in July 1943. The Germans had built a deep defense near Orel and Kursk, and they considered this pivotal point to be of great importance because it covered the approaches to the town of Bolkhov which at that time was the most important German defense position in the direction of Orel. The enemy's intentions were also aided by nature. The village of Tolkachevo, lying on the high bank of the Oka, was turned into a powerful defensive position by the enemy, with a large amount of blindage and many dugouts covered by 5 to 12 layers of wooden beams. All firing positions were dug into the ground and were interconnected by an elaborate network of trenches and connecting passages. The fascists expertly mined the approaches to the village and put up several rows of barbed-wire obstacles running its entire length. It seemed that everything had been considered and done to successfully defend this important sector of the front with a minimum of losses.

This is what the fascists thought. But the Soviet command calculated differently. The enemy defense was well-reconnoitered and the rocketeers were ordered to attack the center of the enemy's resistance, to breach it, and to prepare the way for the unimpeded advance of the Soviet infantry.

The massed salvoes of the Guards mine throwers thundered at the appointed day and hour. Powerful explosions rocked the enemy lair, bringing to light crushed weapons, beams, and rails, and burying the defenders in the dugouts. A powerful hail of fire was followed by an infantry attack. The Tolkachevo "nut," cracked by the fire of the rocket artillery, surrendered after having put up a feeble resistance.

An interesting account of the constant improvement in fighting qualities, and of the heroism and courage of the rocket artillerymen is given by the former zampolit [political deputy commander] of the 2nd Mine-Thrower Guards Regiment, G. K. Smirnov.

"We began the war in the south of the country. On 17 September 1941, we arrived from Moscow at Bol'shoi Tokmak where our regiment was formed. Moscow working people formed the backbone of the regiment. By the second day they had already joined the fighting. It was difficult to fight in 1941. Rocket launchers had only just appeared, and there was little experience with them. We suffered heavy losses.

"The Hitlerites were very much afraid of the 'Katyushas'; they saw in them a strong and effective weapon, and therefore they did everything in their power to destroy them. The fascists endeavored to capture at least one rocket launcher in order to discover the secret of the powerful Soviet weapon. We were especially troubled by enemy aircraft. But all this did not help the Germans. The Guards foiled every enemy ruse and hammered at him mercilessly.

"With increasing experience the destructive power of the rocket artillery grew steadily. The day of 23 August 1943 was a memorable one: our mine-thrower regiment of 'Katyushas' was ordered to support the advance of the brigades of the 2nd Mechanized Corps. From the observation post it could be seen how the neighboring rifle division overcame the enemy resistance and captured the village of Krinichki. But the Hitlerites concentrated their remaining forces and counterattacked; they pressed our forces fairly hard and prepared for a new offensive. There was danger of their breaking through. It was necessary to quickly break up the offensive formation of the fascists who were preparing for another attack. This task was entrusted to the battalion of Guards mine throwers, commanded at that time by Captain M. I. Yakub.

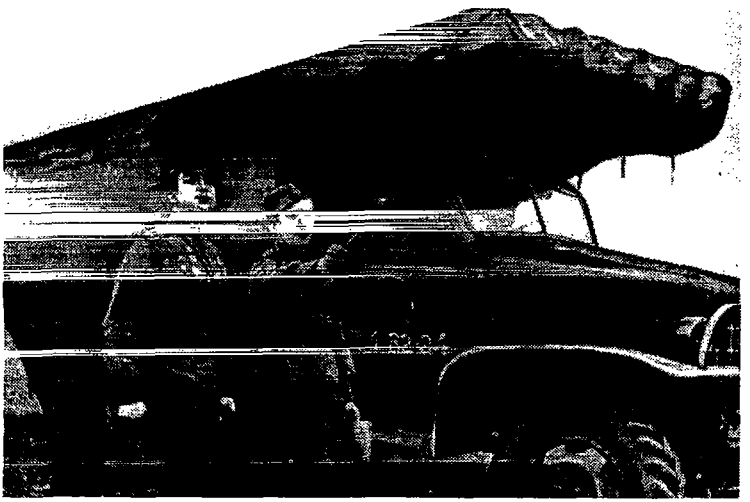
"The battalion commander ordered the battery commanders Sulimov and Frantsuzov by telephone to take up firing positions with their units, and then he quickly calculated the initial data. After 15 minutes, when the battery had covered a distance of 10 km and had arrived at the foot of the Kalmytskii Kurgan, it prepared itself for combat and received the command: 'Fire!'

"At the observation point the officers and generals rushed to the telestereoscopes and quickly raised their field glasses. Everyone present was curious: what would happen?

"Several seconds passed, and then the powerful salvoes of the 'Katyushas' rent the air. Above the valley huge clouds of dust appeared; parts of vehicles and huge fountains of dirt rose into the air. The first salvo was followed by another one. Hitler's thugs were seized by panic; they tried to save themselves in shelters but few of them were fated to survive. Our infantry, inspired by the salvoes of the 'Katyushas', threw itself into the attack and captured Krinichki without much trouble."

The first rocketeers excelled not only in their untiring attempts at improving the methods of employing the "Katyushas." The glorious history of the World War contains also many other examples of heroic deeds of the artillery Guardsmen which were duly appreciated by the homeland.

Once the Hitlerites started a tank attack. From their hidden positions the Soviet heavy artillery fired at them. Tanks from the brigade of Lt. Col. Yakubovskii moved valiantly against the enemy supported by a hail of fire from rocket launchers. One after the other the fascist steel monsters went up in flames. In less than a quarter of an hour the enemy had lost a third of his tanks, but he continued forcing his way toward the Soviet positions.



Details of fighting task being given (1943).

The rocket launchers again prepared to launch their missiles. Sergeant Dudenin was just ready to fire another salvo at the tanks with the crosses on their turrets which continued to advance, when he saw a group of enemy aircraft flying in to bomb the Soviet forces. These planes veered slightly; they had to be on course in order to deliver their attack. The sergeant stopped the launcher from firing a salvo, correctly judging that it would no longer be necessary against the enemy on the ground. The experienced artillery rocketeer set his sights at the first group of bombers. Cool and confident, he calculated the height of the trajectory of the missiles and engaged the firing lever.

Sixteen missiles rose from their guides on the "Katyushas" just at the moment when the fascist bombers began diving toward the Soviet firing positions. Immediately black explosion clouds emerged from the clusters of fascist vultures. Two German planes, burning like torches, dived to the ground. The other fascists lost their eagerness to continue bombing the Soviet positions. They hurriedly escaped westward.

This fighting episode, however, is only one of many, but it proves convincingly that the Russian "Katyushas" in skilled hands appeared to the enemy as a dread weapon that hit him not only on the ground but also in the air. Today it is difficult to say exactly when "Katyushas" were

first used for firing at aerial targets, but in any case their use indicates the high moral qualities and the fighting ability of the soldier who took another step forward in employing the rocket weapon.

In the fighting for the Donbas the soldiers, sergeants, and officers of the 4th Mine-Thrower Guards Regiment, commanded at that time by Major N. I. Popov, exhibited unrivaled valor and courage. This is what Lieutenant General of Artillery I. S. Strel'bitskii, former commander of the 2nd Guards Army artillery tells about the regiment's exploits:

"The third battalion of the 4th Mine-Thrower Guards Regiment received the task of supporting the 33rd Rifle Division. On 27 August 1943 its units were held up by strong mortar and machine-gun fire of the enemy near the village of Sukhaya Krynka. Being without cover, the Soviet forces were in danger of sustaining losses. It was necessary to silence the enemy fire quickly. The divisional artillery immediately opened fire, but it was unable to silence the Hitlerite firing positions hidden on the opposite slopes. It was then that the divisional commander gave the battalion of 'Katyushas' a special task. The battalion commander Captain N. I. Korolev realized that the task was very complicated and exacting, but there were only enough rockets for one salvo. However, the bold commander found a way out. With three scouts he penetrated behind the enemy lines, calculated the initial data and gave orders by radio to open fire. The 'Katyushas', guided by the skillful soldiers, instantly accomplished their task. Two hundred dead and wounded fascists, three disabled self-propelled guns, and several destroyed tanks remained on the battlefield."

Equally glorious was the deed with which the rocketeer Vladimir Terletskii inscribed himself in the golden book of the events of the Second World War.

It was on 28 May 1943. The battery of the 50th Mine-Thrower Guards-Regiment, in which Staff Sergeant Vladimir Terletskii served as driver of a combat vehicle, supported the advance of a rifle division. The advance units fought hard in the area of the Kievskaya cossack settlement in the Kuban area. The enemy put up a furious defense and then went over to counterattack, using tanks and self-propelled guns. It was imperative to stop the advancing enemy immediately. This task fell to the Guards unit. But the first launcher had hardly covered a distance of 100 meters when the command rang out: "Air attack!"

Ahead of them fascist bombers appeared. They counted tens of them. They endeavored to destroy the Soviet "Katyushas" before they entered the fighting. Bombs dropped at short intervals on the road on which the launchers traveled. This did not deter the Guardsmen. The first vehicle driven by Terletskii served as an example to the others.

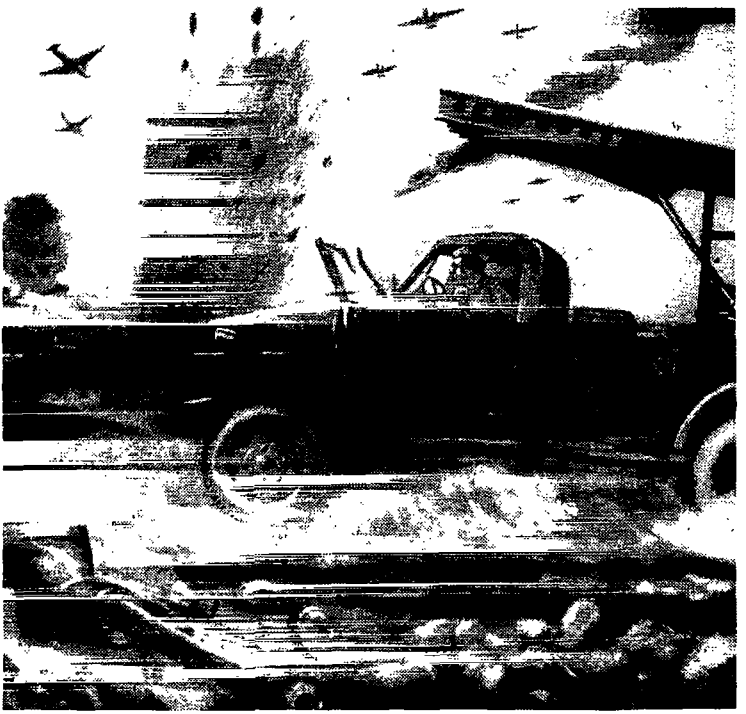
"Step on it a bit more!", the commander ordered.

Vladimir Terletskii bent over the steering wheel, getting as much as was possible out of the truck. He zigzagged around the explosions and drove his combat vehicle forward at top speed. This enraged the aerial pirates. They concentrated all their fire on him.

Splinters whistled past. The cabin had already been hit in several places. Terletskii felt a strong blow in his stomach. Blood was streaming from his wound. Cold sweat covered his forehead. His mouth felt dry. But the driver summoned up his last strength and kept driving. Fighting

pain and weakness, he pressed his hand against his wound and drove his truck onward.

Here was the firing position. Losing consciousness, Vladimir Terletskii saw how the death-dealing missiles with their characteristic roar hit the enemy.



The exploit of Guardsman V. N. Terletskii.

Powerful explosions rent the air. The fascists were enveloped in black clouds of smoke and dust, and their tanks went up in flames. The very earth burned under the feet of the Hitlerites. Panic seized the enemy camp. A thundering "hurrah" sounded all over the battlefield. The infantry had gone in to attack and had captured the designated line.

While consolidating the positions they had won, the soldiers recalled with admiration the exploits of the mine throwers of the Guards. They did not know that Vladimir Terletskii was no longer in their ranks. The heroic heart of the courageous Guardsman, who had done his military duty until the end, had stopped beating.

A decree of the Presidium of the Supreme Soviet of the USSR of 25 October 1943, posthumously conferred on Vladimir Nikolaevich Terletskii, the glorious son of the Soviet homeland, the title of Hero of the Soviet Union.

At his birthplace, in the Pogrebishche settlement in the Vinnitsa Region, the secondary school No. 3 where Vladimir Terletskii had learned adopted

the hero's name. His portrait hangs in the most prominent place, and the older pupils give the younger ones details of the heroic exploit of their courageous townsman.

Another incident which occurred in February 1944 on Belorussian soil which was being liberated from the fascist invaders is equally noteworthy.

The Hitlerites feared the Soviet Guards mine throwers but they never missed an opportunity to try and destroy them; very often they bombed their firing positions and fired at them with artillery. But faithful to the homeland and to the oath given to the nation, the rocketeers guarded the weapon entrusted to them, sometimes with their very lives. Here is such an example:

On 3 February the fascists detected some Soviet launchers in the area of Uzhlyatino-Gorbachi, and made an artillery attack on their concentration. The pressure wave threw fourteen M-13 missiles from their guides on the combat vehicle. In two missiles the rocket fuel began to burn and the mines began moving slowly on the ground in the direction of the four fire-control units and piles of missiles.

The selfless action of D. M. Perov.

A disaster threatened. The first to notice this was the driver of the combat vehicle, Guards Sergeant Perov. He decided instantly on his action. Ignoring the danger, the valiant soldier ran to the missiles and threw himself upon them. But their thrust was too great. Perov found another solution. Without losing a second, the courageous communist removed the

fuse first from one and then from the other missile, and then he turned them in a direction in which they could not do any harm and released them.

To the question of his comrades, whether it was not terrifying to throw oneself on top of the missiles, the soldier replied simply:

"I did not think of that. At that moment there was only one thought in my mind: not to let the missiles do any damage to our own vehicles."

Thus thanks to the presence of mind and courage of Dmitrii Perov, his comrades as well as the four fire-control units and a large stock of missiles were saved. The intention of the Hitlerites were foiled. Soon the battalion of Guards mine throwers took part in another action designed to destroy the manpower and weapons of the enemy.

For his heroic exploit Dmitrii Mikhailovich Perov was rewarded by the high honor of being nominated a Hero of the Soviet Union. His deed is an example of unbounded loyalty to military duties, cooperation, and protection of comrades during fighting.

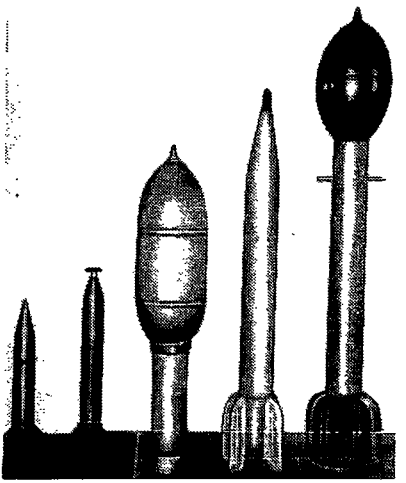
In defensive and offensive battles the units of rocket artillery fought primarily at the most difficult sectors of the front, and they frequently found themselves in a very dangerous position. The "Katyushas" were the most mobile and at the same time destructive weapon, and they were therefore often the last when the forces had to retreat, and the first in an advance.

Single units of the rocket artillery often found themselves in a situation in which they were separated from their infantry and had to fight independently against large enemy formations occupying advantageous positions. However, by skillfully combining the powerful fire of their combat vehicles with small-arms fire, the Guardsmen always dealt the enemy severe blows and emerged victorious from the fights. In June 1944, for example, the unit commanded by Major Tolstoi advanced, and in the area of the village of Zabolot'e it met about 700 Hitlerites. The fascists were escaping from encirclement; they intended to breach the lines and to break out of the ring of fire. They launched an attack. But the artillerymen did not yield. After three battery salvoes two groups of Guardsmen, armed with hand grenades and submachine guns, threw themselves on the raging enemy. A short but heated battle followed in which the rocketeers killed 30 Germans and captured 35, while they themselves suffered minor losses. Taking stock of their situation, the Hitlerites decided to resist capture and to try again to break out of the encirclement. Regrouping their forces, they counterattacked but came under devastating fire from the rocket launchers which fired point-blank, and the Germans had to retreat. In this fight the Guardsmen, under the command of Major Tolstoi, showed firmness, resourcefulness, and the ability to use the new weapon in close fighting, and they killed about 200 German soldiers and officers and captured 72 prisoners.

Another similar incident occurred in September 1944 when a large enemy force, backed up against the shore of theBaltic Sea, tried to fight its way out by strong counterattacks with tanks. To repulse the massed enemy attacks, rocket launchers were also brought up. At first they operated against the tank groups only from covered positions, but the repulsion of each attack required a large number of missiles. That worried

the Soviet command because reserves of ammunition were rapidly being depleted while the enemy continued attacking ever more furiously.

It was then that the commander of the battalion of "Katyushas," Major P. Dyudyukov, decided to fire point-blank at the Hitlerite tanks and infantry. This task was entrusted to the Guards unit of Master Sergeant Koshkarev which was best prepared to carry it out. As soon as the enemy tanks came into sight, the rocket launcher was ready for action. All that remained was to choose a position from which point-blank fire by rockets would be most effective. The commander carefully scanned the surroundings and ordered the driver to drive to the edge of a forest and to stop the truck with the rear wheels on a mound. In such a position the guides aimed directly at the advancing enemy. The adversary noticed the combat vehicle and opened artillery fire on it. Shells fell in a tight circle all around the launcher, but that did not frighten the audacious rocketeers.



Missiles at the time of the Second World War.

Sighting the enemy, the master sergeant adjusted the guides more accurately, aiming at the attacking tank column, and when it was only 1,000 meters away, he threw the switch. With a great roar the missiles streaked toward the "tigers" and "panthers." After a few seconds the driver quickly took the machine to a safe place. Observing this unusual spectacle, the Soviet soldiers and officers noticed with pleasure that several enemy tanks were left on the battlefield. Belching clouds of black smoke, some other tanks also staggered helplessly over the field. The heroes of the unrivaled feat were already preparing for another fight.

The further the Soviet forces penetrated westward, the greater was the importance of the Guards mine throwers.

Units of the rocket artillery brought particularly valuable assistance to our forces fighting for large inhabited regions in Germany itself where the Hitlerites turned every stone building into a fortress. When the Soviet forces advanced on Berlin, they had to penetrate a number of fortified defense belts in addition to storming towns and villages well-adapted to defense.

In the streets of Berlin many barricades of stones and bricks had been put up, and in front of them there were all sorts of antitank obstacles. Large buildings in the town, especially those at street intersections and squares, had been adapted to prolonged defense. In the walls of such buildings embrasures were prepared, and basements were fortified and armed with machine guns and antitank weapons. Upper stories and lofts were intended for snipers and small-arms fire. To hide troops and

armaments the Germans made extensive use of the tunnels of the city's underground. Everything possible was turned into some kind of fortress capable of putting up considerable resistance.

To pierce such a system of fortifications was not an easy task. It was imperative to find a powerful weapon capable of wrecking buildings before their actual storming, of flattening barricades, of destroying centers of resistance. The mine throwers of the Guards provided such a weapon.

The action of the rocket launchers under such conditions is well-characterized by the following example:

The Soviet assault groups had the task of driving the enemy from a large building situated at the intersection of Lindenstrasse and Kommandantenstrasse. By holding this fortress, the Hitlerites had already blocked the advance of the Soviet forces for several hours. Conventional artillery had already scored several direct hits and had caused the enemy heavy losses, but it could not solve the problem entirely. Then the command gave orders to destroy the building with rockets. The Guardsmen of the rocket artillery drove their machines to within 150 meters of the building under a hail of machine-gun and mortar fire. The first salvo pierced the walls of the building and the missiles exploded inside it. The pressure of the explosion destroyed the entire front wall, and the floors in the upper stories crumbled. Anything flammable in the house caught fire. Most of the enemy were buried in the ruins.

Having undergone its baptism of fire in the air and on the ground, the Russian "Katyusha" began capturing the sailors' hearts.

The Soviet designers who worked in the field of armaments fully appreciated the rocket weapons, and turned their attention increasingly toward introducing them into the navy and river flotillas. At the beginning of 1942 experimental work in this field was concluded, and soon the sailors greeted the rocket weapons with great enthusiam.

Among the first to operate this powerful weapon in the navy were the crews of submarine hunting boats from the flotillas of the Novorossiisk naval base. As early as March 1942 the weapons, which seemed so unusual to the sailors, appeared on board the naval vessels. The weapons were very much like gun carriages but on top of them were grilles with metal slides, viz. the guides. An experienced observer could easily detect their relationship to the rocket launchers, the "Katyushas."

The day came when the submarine hunting boats, in addition to their 54-mm cannon and heavy machine-gun fire, also attacked enemy aircraft with salvoes of rockets having time fuses. These salvoes heralded a new weapon of the navy which was destined to change radically the combat potential of the vessels as well as the character of sea battles altogether.

After the first antiaircraft salvoes of the submarine hunting boats the specialists realized that unless the missiles were specially adapted, their use against aerial targets was not sufficiently effective. At that time the boats each had two rocket launchers, each of which could launch not more than four missiles simultaneously. In addition, recharging took considerable time. It was therefore impossible to create a reliable and dense screen of explosions in the path of enemy bombers, especially when they went into diving attacks.

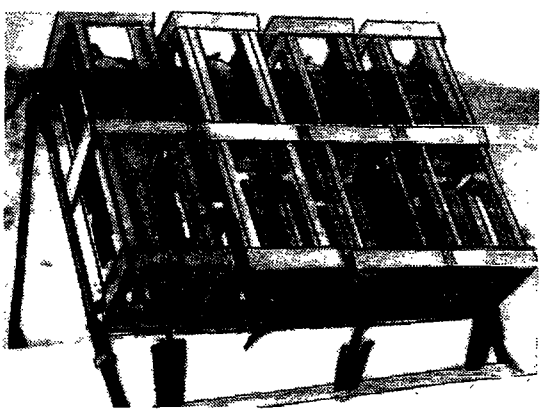
On account of this it was decided to use the missile boats mainly for firing at surface and ground targets. At the same time measures were

taken to improve the launchers in order to increase their firing power. This change-over took several months. In autumn 1942, on a warm day in Sukhumi, an armored boat left port and headed for the open sea. This time there was, in addition to the regular crew, also a group of soldiers, sergeants, and officers of the Guards mine-thrower units on board. They observed the unaccustomed seascape and enjoyed the beauty of the Black Sea. However, this was not a pleasure trip. The boat stopped at the designated area. The target was clearly outlined at a fairly great distance from it on the water: an old barge. An officer with the distinctions of an artilleryman of the Red Army gave the order: "Prepare for combat!"

The soldiers quickly uncovered the rocket launcher which had been mounted on the boat, and prepared it for firing. A group of sailors followed their practiced skillful movements with interest. Of course, they felt like saying:

"Well now, you Guardsmen, show us what the vaunted 'Katyushas' can do!"

A special commission was evaluating the suitability of the Guards mine throwers for firing at seaborne targets.



Metal frames containing 280-mm missiles before launching.

The battery commander, who for the first time commanded a unit at sea, tried to ignore the curious glances of the members of the commission. He acted quietly and confidently, being well-aware that a decision was now being made concerning the "Katyushas": whether they were to be included among the armaments of the navy.

When everything was ready, the artillery officer ordered: "Fire!"

A salvo of "Katyushas" roarded thunderously. For a moment the target was hidden by the frequent explosions of the missiles, and then it was rocked and went down.

"Excellent!" Thus the naval specialists assessed the blow delivered by the "Katyushas."

After this trial the rocket launchers were quickly incorporated as armament of the naval boats.

One of the first attacks on the enemy was made by boats during the night of 12 December 1942. In the area of the hamlet of Aleksin, southwest of Novorossiisk, Soviet scouts discovered a strong concentration of fascist forces. How could they be destroyed? This could best be accomplished by an attack from the sea. The command detached two pairs of missile boats for that purpose; they had to fire missiles from the sea to the shore. The sailors made careful preparations. Skillfully calculating the distance, the Black Sea sailors unexpectedly opened fire at the enemy. They did not fire all the launchers at once, but rather successively. While one pair of boats fired, the other followed in its wake, reloading its launchers. After a short time each boat taking part in the raid had fired five salvoes. The flashes of the explosions, clearly visible from the vessels, indicated that the task had been fulfilled successfully.

No less successful was the firing of rockets from the specially armed vessel "Skumbriya." On the night of 4 February 1943, this vessel took part in the supporting fire covering the first landing party near the wharf of the Rybzavod [Fish Product Plant] on the western shore of the Tsemeskaya Bay, close to the southern outskirts of Novorossiisk. Each salvo of the "Skumbriya" consisted of 96 missiles, and they all found their target exactly.

The great success achieved in the first launchings of rockets from small ships was the basis for the further arming of an entire group of Black Sea torpedo boats with rocket launchers. They were called artillery boats. Within a single month of fighting in the beginning of 1943 the Black Sea sailors carried out eleven successful firing raids with their new boats and destroyed a number of important ground targets. For example, at an airfield near Anapa the missile boats set several enemy aircraft and an ammunition dump on fire. In the area of the village of Blagoveshchenskoe they destroyed a large concentration of enemy troops.

Their mastery of the rocket weapons improved from day to day. They discovered many new possibilities for utilizing the powerful weapon. Firing only at ground targets no longer satisfied the sailors. They were burning with desire to demonstrate the power of the missile boats in a naval fight as well. Such an opportunity soon arose.

In March 1943 two missile boats were on night patrol on the sea, south of Novorossiisk. Suddenly and unexpectedly a group of enemy torpedo boats appeared on the horizon. The adversary, perceiving his numerical superiority, mounted an attack and furiously opened machine-gun fire.

The Soviet sailors boldly met the enemy. The fighting started. The Germans decided to attack the Soviet boats in turn and concentrated their fire on the one nearest them, marked SKA-084. But its commander, First Lieutenant Vladimir Shkola, firmly believed in the courage of his crew and the power of the rockets, and he defiantly led his boat toward the enemy. When the distance between him and the nearest enemy boats was most advantageous, the officer gave the order to fire rockets at the fascists.

Two salvoes thundered. One missile hit an enemy boat which sank instantly. The other fascist boats quickly withdrew and hid in the wide expanse of the sea.

On the rivers powerful salvoes of rockets also thundered. At the time of the fighting on the Volga three armored boats, armed with launchers for 132-mm missiles, joined the fighting vessels which gave firing support to the ground forces. By the middle of October 1942 they already had to their credit more than twenty combat firings, mostly from previously chosen firing positions near the left bank, anchored or moored at advantageous points.

Subsequently the number of armored boats equipped with rocket launchers increased. Their use in combat improved. The participants of the battle for the fortress town on the Volga very warmly recall the operations of the armored river boats which excelled by the heroism, endurance, and self-sacrificing actions of their crews.

After the operations on the Volga were finished, all the missile boats of the Volga flotilla were transferred to the Sea of Azov. After a few months they had already gained fame in giving supporting fire to the main landing operation on the Crimean shore, north of Kerch.

The sailors of the Onega flotilla were equally skillful in using the rocket launchers. They learned to use this dread weapon very well, and they fired it whenever the situation permitted. The stable front of the ground forces, skirting the Onega Lake, their skillful cooperation with it, and careful reconnaissance all helped them. The following episode illustrates their effectiveness:

A group consisting of six missile boats and two guard boats was ordered by the army command to crush a key position and concentration of enemy forces in the area of the Onega bypass canal. Even before this, the sailors had decided that the greatest effect can be attained by rockets if fired unexpectedly and simultaneously from several boats. They decided to use this method.

At dawn on 22 August 1943 the missile boats advanced to the area of firing. They arrived at the appointed place where the salvo was to be fired at 0401 hours. As soon as the vessels arrived at the previously determined place a salvo from all boats was fired simultaneously. All at once, 128 missiles were launched.

Two minutes later an identical salvo was fired at the same target. Exploding missiles, fires, and explosions in the enemy positions indicated that the target had been hit.

Great damage was inflicted on the enemy by the rocket artillery stationed on the vessels of the Danube Red-Star Flotilla, Bearer of the Nakhimov and Kutuzov Orders, which participated in a number of offensive actions during the Second World War.

Here, as everywhere, the artillery rocketeers showed much creative ability, resourcefulness, and skill. Enemy troop concentrations were bombarded at their flank near the river by vessels of the flotilla firing independently or in close cooperation with the artillery of the attacking units. The raids were most effective, however, when the missile boats advanced up the Danube into the depth of the enemy defense, since there were important targets which were invisible from the army observation posts.

It was particularly in such audacious raids that the missile boats commanded by First Lieutenant G. Bobkov made a name for themselves in the battles for Komarno and Bratislava. After the victorious conclusion

of the fighting the first flotilla of boats armed with rockets received the honorary designation "Bratislava flotilla."

A large number of vessels of the Amur Red-Star flotilla were armed with rocket launchers. A number of rocket-firing exercises took place here, a scheme for controlled simultaneous firing from an entire flotilla at one ground or seaborne target was devised. This made it possible to fire rockets successfully right from the beginning of combat actions by the vessels of the flotilla against the Japanese imperialists.

At dawn on 9 August 1945 the Soviet missile boats heavily bombarded an enemy troop concentration and defensive weapons near the town of Fuyuan. The panic which broke out in the bombarded Japanese units and the defeat of a powerful enemy center of resistance on the shore permitted the boats carrying a landing party to effect a landing of the advanced units in order to capture the town.

On the evening of 10 August the vessels of the Amur flotilla bombarded the area of Kaichia, one of the most powerful centers of Japanese resistance, with artillery. Moving upstream on the Sungari, the missile boats hit concentrations of enemy infantry. The firing on 18 August at the approaches to Sansing [Ilan] was especially successful.

In the Pacific navy missiles were used to support the navy landing on the Kuril Islands.

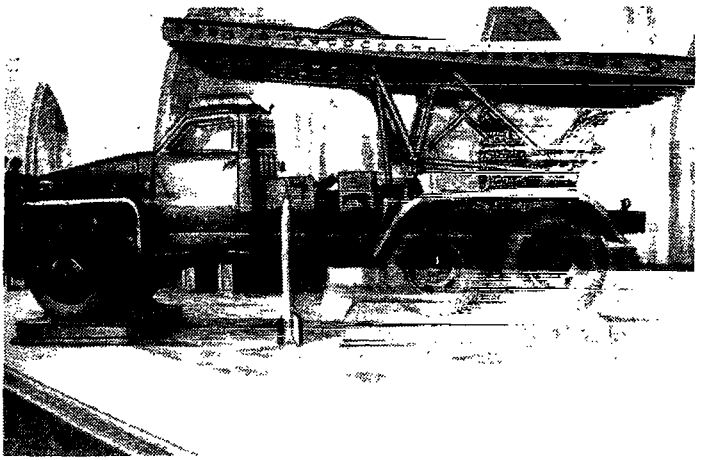
The history of the Second World War provides many more outstanding examples of blows inflicted on the enemy with rockets by the Soviet navy; the strength of these blows increased with every day that passed, and the methods of using rockets in combat were continuously improved.

Thus in heavy fighting against a strong and cunning enemy fighting methods with rockets were born and perfected on the ground, in the air, and on the sea. Thus our Soviet homeland learned for the first time about the exploits of the Soviet rocketeers, whose predecessors had devoted much knowledge and experience to their famous work.

Only a few episodes have been described here of the application of rocket artillery on the fronts during the Second World War, and only a few of the thousands of heroes were named who skillfully used the menacing rockets and thereby upheld the honor and dignity of their country. But even these demonstrate convincingly that the first rocketeers occupy a distinguished place among the war heroes.

The country gave high recognition to the deeds of the artillery rocketeers. Many of them were decorated with orders and medals, and many received the highly honored title of Hero of the Soviet Union. The names of many Guardsmen of mine-thrower units who fell fighting against the German fascist invaders, as a sign of recognition of their courage and heroism, were inscribed in the records of existing units.

The "Katyusha" No. 3354, exhibited in the Museum of Artillery History of the Soviet Army in Leningrad was a witness to the military glory of the mine throwers of the Guards. This combat vehicle, which had begun its combat life near Leningrad and traveled more than 17,000 kilometers during its "lifetime," is the best witness of the heroic exploits of the Soviet artillery rocketeers. It launched about 3,700 missiles against the enemy. It has to its credit two destroyed tanks, more than ten machine guns, more than twenty motor vehicles, and about 700 enemy soldiers and officers, killed or wounded.



A "Katyusha" which took part in the Second World War, placed for eternal keeping in Leningrad.

The fighting documents belonging to this legendary "Katyusha" have also been preserved. Though brief, they speak clearly of the heroic deeds of the crew which covered a long and hard path of fighting together with the launcher.

The museum has other no less valuable exhibits, including texts pertaining to the valorous deeds of the first Soviet rocketeers during the years of the Second World War.

Poems and songs composed by the people about the mine throwers of the Guards constitute a noteworthy memorial to the glory of the rocketeers. The terrible war period has long passed, but even today one can hear in the streets of towns and villages and in military garrisons an occasional humming of the song by Mikhail Vasil'evich Isakovskii, which was so popular in wartime. It begins with the words:

On the sea and on land
Over front-line paths
Treads the Russian "Katyusha"
Treads with fighting steps...

The love of the entire people for the heroes of the Guards is well conveyed by the affectionate name of a Russian woman, Katyusha. This expresses everything.

The young generation of contemporary rocketeers is brought up to follow the example of the valor, heroism, and high fighting skill of the Guardsmen of the mine-thrower units. This generation has adopted from its predecessors in combat everything that time has proved to be best. In their actions they have proved to be equal to those whose deeds and exploits have been appreciated by the people and noted by the homeland. The most characteristic traits in the combat exploits of the first rocketeers were their sudden appearance at the most difficult sectors of the front; their speed and determination in firing; their ability to pick the most important and the most dangerous from among

a number of targets, and to destroy them quickly and accurately; their ability to fire a maximum of explosives at the enemy within the shortest possible time, when necessary; and their ability to shatter the enemy morally as well as physically. These and other traditions of the Second World War took root among the rocketeers. They have been further strengthened and developed, and have become a standard of the behavior of the soldiers.

THE FLIGHT INTO THE UNKNOWN

While the menacing "Katyushas" battered the enemy in the air, on the ground, and on the sea, the foremost scientists in the country were assidiously seeking ways to use rockets as aircraft engines. The idea was not new. Kibal'chich had already voiced it, but it could not have been realized until the war, when it became obvious that very strong engines were indispensable in providing aircraft with much greater speed than could be achieved with piston engines. All the scientists began to consider rockets for this purpose.

Designers, engineers, and workers of the aircraft industry had labored long and hard before the first jet aircraft in the world was ready to fly. Although everyone connected with the construction, testing, and introduction of the new aircraft anxiously awaited this moment, for many it came unexpectedly, even for the famous test pilot G. Ya. Bakhchivandzhi.

During the winter, at the beginning of 1942, Grigorii Yakovlevich Bakhchivandzhi was recalled from the front and returned to his former occupation as test pilot. As soon as he entered the institute, the keen airman spent much of his time on study, since he already had plenty of experience. Together with his comrades he diligently studied the theory of jet flight. One day the commander called him and said: "Comrade Captain, you are charged with a very serious task; the testing of the first rocket aircraft in the world is being entrusted to you."

Although Bakhchivandzhi already knew that the first experimental planes with liquid-fuel rocket engines were ready for testing, the commander's notification nevertheless impressed him deeply. "At last it is done," the courageous pilot thought to himself. But aloud he said:

"Aye, aye. I will do all I can to carry out this serious task successfully."

From that moment on Grigorii Bakhchivandzhi's life took a completely new turn. Even before, intense study had been his main interest — his very aim in life. There were moments now when he thought of the past while preparing for the future. The bold Soviet pilot thought of his life in the air force, and asked himself whether his strength, knowledge, and experience would suffice for his responsible task. He recalled his youth in the Komsomol spent in the town of Mariupol, the unforgettable year 1932 when he was accepted as a member of the great Communist Party, his experience at the flying school, and then his work as test pilot. With special pleasure he remembered his memorable meetings with Valerii Pavlovich Chkalov, the eminent Soviet flier. These meetings did much to improve his flying skill.

Again flying and ... war. Grigorii Yakovlevich Bakhchivandzhi defended Moscow. He had to his credit 65 fighting missions, 26 air battles, 5 enemy aircraft shot down personally, and another 10 together with his squadron.

The fighting experience he accumulated during half a year of war was very valuable. Bakhchivandzhi knew very well what was still lacking in aircraft, and all his efforts were directed toward constructing a fighting aircraft which would fully meet the high requirements of the front.

Grigorii Yakovlevich attempted to prepare himself as well as possible for the important test flight. New books appeared in his personal library, and among them the place of honor was accorded to the works of K. E. Tsiolkovskii and other Russian scientists who wrote about rockets and the theory of high speeds.

Leafing through the pages of the manuals, Bakhchivandzhi often thought of the prophetic sentence pronounced by K. E. Tsiolkovskii: "After the era of propeller aircraft will come the era of jet aircraft." These words deeply moved Grigorii, and gave rise to many new ideas. How could he help being thrilled? He was the first to enter this era — to open it up.

G. Ya. Bakhchivandzhi.

Bakhchivandzhi was often to be found in the company of the designers of the first jet aircraft. Together they drafted the main outlines of the prototype under construction, and discussed details of the forthcoming tests. These interesting meetings between Grigorii Bakhchivandzhi and the foremost Soviet designers inspired him and gave him strength, energy, and enthusiasm in his preparation for the coming flight.

Grigorii was often at the test bench of the engine of the future prototype. He observed the way the liquid-fuel rocket engine started and operated, and he familiarized himself with its numerous and varied peculiarities.

Many days of strenuous work went by and in 1942, preparations were essentially completed. A small silvery aircraft of unusual shape (type BI-1) awaited the pilot. Its appearance was startling — it had no propellers. The

liquid-fuel engine was situated in the rear part of the fuselage, while fuel tanks and air cylinders were in front.

People who had been used to aircraft with piston engines, stared at this "apparition from another world" and were curious about its capabilities.

In the opinion of some people, even former airmen, the simple streamlined shapes were not at all in harmony with the completely new flight properties of the machine. But that only seemed so. As soon as Bakhchivandzhi sat in the cockpit of the new fighter and started the powerful rocket engine, the plane was suddenly transformed. A mighty roar, similar to thunder, spread far beyond the airfield, and testified to the great hidden strength.

Bakhchivandzhi had begun his flight preparation according to a plan prepared previously. The first days he practiced starting the engine, and later he took short taxiing runs across the airfield. The day of his first flight was soon fixed — it was to be on 15 May 1942.

On a warm sunny morning an excited but determined Grigorii hurried confidently to the airfield. He went to the aircraft, and as was his habit, circled the machine several times. The engineers and technicians finished the final preparations. Unfortunately the weather broke, clouds covered the sky, and at the appointed hour the flight could not take place. Time passed slowly; this wearying waiting lasted almost until evening. Finally a strong wind scattered the clouds and the long-awaited sun shone.

Designers, test pilots, and members of a government commission went out to the airfield. Everyone was solemn, and tried to say something warm and encouraging to the pilot.

V. F. Bolkhovitinov, one of the designers who built the aircraft, approached the plane (whose engine he had already carefully examined), embraced and kissed the pilot, and wished him success in fulfilling his responsible task with honor.

The pilot slowly entered the cockpit and signaled that he was ready.

The "all clear" signal was given.

At that moment the silvery winged bird came to life. A stream of fire roared from the nozzle of the engine. The plane shuddered, began moving and, gaining speed, sped down the runway. It moved faster and faster, left the ground, and was air-borne. It did not hover above the ground, as was usual, but immediately shot upward and gained speed.

The spectacle was unusual. Everyone present at the airfield was tensely quiet. Then came a joyous sigh of relief: a great event of the century had just taken place — the first rocket aircraft in the world was aloft.

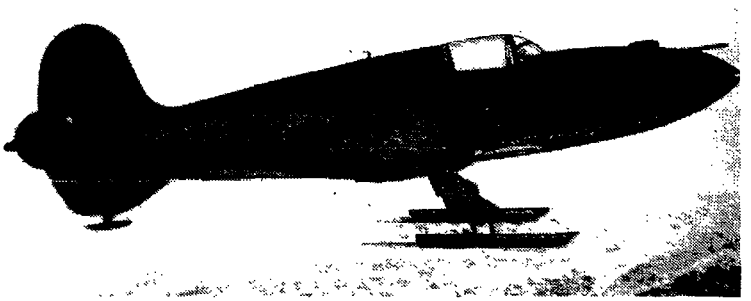
Calmly watching the controls of the machine, Grigorii Bakhchivandzhi felt himself pressed into his seat by a strong force which carried him powerfully higher toward the Sun, leaving the clouds below. All the instruments and engines worked faultlessly. The aircraft obeyed the pilot perfectly.

Following the given flight route, Bakhchivandzhi began to land his machine. Again there was anxiety at the airfield: how would the landing be achieved at such speed? However, worries were soon dispelled: the test pilot, having well calculated the distance, time, and speed, made a perfect landing.

Bakhchivandzhi emerged from the cockpit, and reported the successful fulfilment of his task to the flight commander. However, this was obvious to everyone even without his report. Everyone wanted to embrace and kiss the hero, and shake his hand. Overwhelmed, the pilot could hardly free himself from the warm embraces.

Afterward a meeting took place. In the front of the meeting hall there was a red banner with the exciting words: "Welcome Captain G. Ya. Bakhchivandzhi, the first pilot to have flown into the unknown." Grigorii sat on the dais. Listening to his comrades, he imagined future jet aviation, and unlike the others, he visualized its impetus and its terrific speeds.

The BI-1 aircraft which G. Ya. Bakhchivandzhi had flown was really a piloted winged missile, and its first flight was very similar to the flight of a missile, although the fuel reserves were small. The name of the enthusiast of rocket flights, the pilot Grigorii Yakovlevich Bakhchivandzhi, has achieved a worthy place in history as the predecessor of the remarkable Soviet cosmonauts.



The rocket aircraft designed by V. F. Bolkhovitinov and flown by G. Ya. Bakhchivandzhi.

When the first rocket aircraft appeared, interest was aroused in high-speed aerodynamics, the foundation of which had been laid as early as 1900 by the Russian academician S. A. Chaplygin. His theory could be fully appreciated only recently when the attack on the sound barrier began. Already at an aviation congress held in Rome in 1916, it was recognized that Chaplygin's paper "On Gas Jets" was the best that had been submitted to the congress on this subject.

A great contribution to the field of rocket-propelled aircraft flight was made by S. A. Chaplygin's successor, S. A. Khristianovich, and by many other Russian and Soviet scientists.

This was a culminating point. A rocket used as an engine in an aircraft lifted a man into the air for the first time. Bakhchivandzhi's flight inaugurated a new era in which rockets were used for flights in the atmosphere, and later also into space.

Similar work was done not only in the Soviet Union but also abroad. Especially in fascist Germany, scientists worked feverishly on applications of rockets for military purposes. It is well known that the Germans succeeded in building two types: V-1 and V-2. They used them for bombarding London. However, these rockets were far from perfect, and were a threat to the English only in the beginning. Toward the end of the war the Londoners had learned to deal with them so well that out of every ten aerial missiles launched by the Nazis, nine were shot down.

The fascist invaders also failed to win recognition with their jet aircraft which appeared during the last days of the war. Believing that they could stun the Soviet forces with a new weapon, they dispatched several jet planes to the front. This did not impress the Soviet airmen very much. The Nazi's first jet-propelled aerial pirate was shot down by the famous Soviet pilot, triple Hero of the Soviet Union, Ivan Nikitich Kozhedub. He himself described this aerial fight as follows:

"On 24 February Titarenko and I flew as a pair on a free 'hunting mission.'

"I scanned the air carefully. Out of the mist I saw an aircraft appear suddenly at a height of three thousand five hundred meters. Not having spotted us, he flew along the Oder at a speed that represented the maximum of our "Lavochkins." I saw clearly that it was a jet aircraft. Quickly turning around, I completely opened the throttle and began chasing him. The fascist pilot, obviously relying on the greater speed of his plane, did not look back. At first I was afraid that upon seeing us he having superior speed would escape.

"I squeezed out of my machine all it had in order to reduce the distance and reach the enemy plane. My partner did not lag behind.

"Knowing his zeal, I warned him not to lose his coolheadedness and not to act without orders from me.

"I wanted to have a good look at the enemy jet aircraft from close range and, then if possible, to open fire on it.

"I dropped lower and approached the German from behind at a distance of two hundred meters. A fortunate maneuver, quick action, and the speed of my plane permitted me to get close to the jet plane.

"Suddenly, unexpectedly for me, tracers began hitting the jet — my partner had not held out. I was convinced that the "old fellow" had spoiled my intentions, and I cursed him inwardly without mercy. But as it turned out, his tracers made my task even easier. The enemy aircraft made a left turn, toward me, and so for a moment its back was exposed to me. At that moment, I reached my plane's maximum speed and got near the enemy. There was only a short distance between us. Excitedly, I opened fire. The jet aircraft broke up in the air and fell down, onto enemy-occupied territory."

This is one of the pages in the inglorious history of jet planes used by Nazi Germany during the Second World War.

The outstanding achievements of Soviet aviation before the war, its obvious predominance over German fascist aviation during the Second World War, and finally the successful testing of rocket and jet planes proved that Soviet scientific and design trends were moving in the right direction.

It is noteworthy that the research and construction of the new aircraft were not confined to a narrow circle of some design office, but were rather undertaken by a number of gifted teams, consulting each other and yet each going its own way.

Disregarding the difficult wartime conditions, the creative spirit of the Soviet scientists, designers, and engineers kept them working steadily and confidently, achieving new and valuable results. For example, the famous Soviet aircraft designer N. N. Polikarpov and the team he led worked

hard at building a fighter aircraft with a liquid-fuel rocket engine. This plane was known under the name "Malyutka" [baby boy]. Another team headed by M.K. Tikhonravov designed an aircraft which was designated 302. In the years 1943-1944 the design office headed by A.I. Mikoyan began work on a fighter plane powered by a combination of a piston engine and an air-breathing jet engine. Later on almost all the Soviet aircraft were powered by turbojet engines, instead of by liquid-fuel rocket engines, and were based on the same principles as rocket engines but were more economical in flights in dense strata of the atmosphere. In aviation circles a new name — jets — was established.

Although jet engines made greater flying speeds possible, the designers and engineers did not attain these speeds at once. In the first postwar year, a speed of more than 1,000 kilometers per hour was attained. This was already a major achievement, and satisfied even the wild imagination of the famous Soviet aviator Valerii Pavlovich Chkalov. He had written in one of his articles that he would like to fly in a plane at this speed of 1,000 kilometers. His successors at first reached and then far surpassed this dream: they began the struggle to attain supersonic speeds.

The first Soviet jet planes at an aerial parade.

Supersonic speed concerned not only Soviet designers and airmen. Over a long period of time, attempts had been made in many countries to break through the so-called "sound barrier," but all were unsuccessful, and often ended tragically. The French pilot Konstantin Rozanov met his end in an attempt to break the "sound barrier." The attempt to fly faster than sound also ended tragically for the English aviator John Derry. His aircraft literally disintegrated in the air. The American aviator Werdin who started in a Skyray F4D plane was also unsuccessful. [Spelling of proper names has not been verified.]

Work on crossing the "sound barrier" was also conducted in the Soviet Union, but differed radically from the work done in the West. In the Soviet Union everything was done to ensure that once supersonic flights were attempted, there would be no great risks involved. First of all, special centers were created where scientific and research work was carried out on a broad basis. In these institutions intense effort was directed toward anticipating difficulties down to the most minute details and at eliminating the possibility of fatal accidents in supersonic flights. Only now is it possible to appreciate fully the farsightedness of Soviet science which was so successful. At TsAGI, supersonic speed was attained as early as 1946. Careful experiments and the construction of excellent planes enabled Soviet pilots to exceed the speed of sound in ordinary test flights in 1948 without risking their lives. This happened under interesting circumstances.

The design office headed by Lavochkin built a new jet aircraft (La-168). Two such planes were built simultaneously. The honor of testing them fell to the pilots A. P. Suprun and O. Sokolovskii. Suprun's plane was powered by an engine of British design, whereas the second plane had a Soviet BK-1 engine, which has now become obsolete. After painstaking preparation for the tests, the pilots received the task of attaining the maximum flying speed. On a clear summer day the two machines rose into the air. The first plane, powered by a British engine, was unable to attain the speed of sound, whereas the second plane, with the Soviet engine, attained supersonic speed. Thus, at the first stage of the struggle for reaching supersonic speed, the superiority of Soviet science and technology was already obvious.

This event is now only of historical interest, but at the time its importance could hardly have been overrated. For the first time man succeeded in breaking the "sound barrier." He was able to test, to feel the hitherto unknown speed, and what was most important, to find out how planes would behave beyond the sound threshold — what new traits would be revealed in such fast flight. This and all subsequent tests helped aircraft designers, engineers, and flight personnel to uncover many secrets of supersonic flight, enabling them to overcome difficulties which occurred under the new conditions, and to build beautiful planes particularly adapted for such flight.

The Soviet pilots learned very quickly to fly jet planes and correctly took into account all the new moments which jet engines introduced into piloting techniques. With their meticulous work, valor, and high skill they clearly disproved the views held in the West that complicated figures and aerobatics on jet planes were impossible because of excessive overloading, immense efforts needed for piloting, and traits of the engines such as bad pickup, etc.

The Soviet airmen proved in practice that a jet plane in skillful hands is an excellent machine, capable of doing anything a propeller aircraft can do. The Soviet pilots learned not only excellent individual aerobatics, but the most difficult group aerobatics using jet engines, thereby making an invaluable contribution to aviation.

One of the first opportunities of demonstrating the successes of the Soviet pilots in mastering jet aircraft was the May-Day parade in 1946, when, above Red Square, squadrons of military aircraft were complemented

by jet fighters, led by the airmen I. Polunin, I. Koshel, and I. Klyukin. "Pravda" wrote at the time: "They flashed past the square. They literally flashed past and did not fly past. In other words, their speed is indescribable." Later achievements of Soviet aviation were successfully demonstrated at aerial parades, where the skill, training, and valor of the Soviet airmen surprised the entire world.

The use of rockets in planes was firmly established, not only as weapons, but also as engines. Jet aircraft emerged successfully from the experimental stage and became the basis of the Soviet Army's air fleet, as well as the basis of civil aviation.

The high level of development of Soviet science and technology gave rise to a new problem: a rocket capable of attaining outer space was needed. Simultaneously with the construction and perfection of jet aircraft, the foremost scientists, engineers, technicians, and workers of the Soviet Union worked on the construction of such rockets.

"GREETINGS, UNIVERSE!"

Having penetrated all conceivable terrestrial space, rockets began aiming at outer space. The enormous development of Soviet industry after the war meant that flights beyond the atmosphere could be attempted. Who would be the first to overcome earth's gravity, the Russians or the Americans? This question in the middle of the twentieth century had a political flavor because the first to enter space could only be the country that was the most developed economically and was foremost in science and technology. This country proved to be our homeland, the Union of Soviet Socialist Republics.

It was an ordinary autumn day, Friday, 4 October 1957. Life on all continents of the Earth flowed steadily and rhythmically. But then something happened that captured the attention of people all over the world. This event was the launching in the Soviet Union of the first artificial Earth satellite in the world.

"On that day," wrote the former President of the Academy of Sciences of the USSR, academician A. N. Nesmeyanov, "our homeland raised the flag of a new era in the history of mankind; the era of the conquest of space. This event ranks with such revolutionary landmarks in the ascent of human society as the discovery of fire, the invention of the steam engine, the discovery of electric current and its connection with magnetism which was the basis of electrical engineering, the start of the first airplane, and the release of the energy of the atomic nucleus."

The day of 4 October 1957 was not only the day with which a new era began; it could be called the day of the world's "recovery of sight." It was remarkable that a satellite of 83 kilograms could be launched.

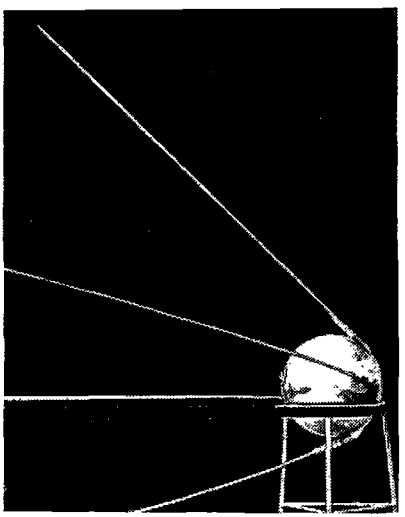
How did the Soviets achieve this?

The less perspicacious critics said: "A gimmick; it is simply a piece of iron; we could also effect such a launching, but we just do not want to." Such words sounded ridiculous and stupid. The bourgeois propagandists themselves realized this very soon; then they thought up a new propaganda trick. "The Soviet Union launched a satellite," they shouted, "but that is their only achievement, and it was merely accidental. The superiority of the USSR in space will not last very much longer."

But this line did not last long either. The world could see that the achievements of the Soviet people in conquering space were not accidental, but rather the result of long, hard, and persistent labor of a large group of scientists, engineers, workers, and administrative staff, inspired by the interest of the party and the government. As early as May 1949, a research rocket was launched vertically for the first time in the Soviet Union to a height of 110 km. After that followed a number of launchings of rockets of the same type. In these rockets the weight of scientific instruments even then amounted to 120-130 kg.

The investigation of the upper layers of the atmosphere progressed considerably after a new rocket had been constructed, which in May 1957, with experimental instruments weighing 2,200 kg altogether rose to a height of 212 km.

Hardly a month had passed after the launching of the first artificial Earth satellite when the space "home" of Laika appeared in the sky. This launching was not a repetition of the previous one, but represented a new stage in the space program. The experiment was based on a completely new foundation. The weight of the satellite was more than six times as great, and its sojourn in space answered a number of additional problems.



The first artificial Earth satellite launched in the Soviet Union on 4 October 1957.

The third satellite, which went into orbit on 15 May 1958, was rightly called a scientific laboratory. With its aid, Soviet scientists solved nine basic problems which were openly stated in the research program.

Thus began the space age. The rocket which had gained great popularity on our planet received a new task, and turned from an Earth-bound into an interstellar vehicle. Utilizing the powerful force of the rocket, the scientists of the Soviet state continued to work on the program of space research.

The Soviet Union was the first to launch a space vessel toward the Moon; it sent the first artificial planet into orbit around the Sun; and it effected a flight of a space vessel toward the planet Venus. One after the other, Soviet space vessels and satellites with living beings on board flew into space and returned safely.

Then came the day when man — master of the Earth himself, a citizen of the Union of Soviet Socialist Republics — traveled into the wide expanses of outer space.

Mankind will always remember 12 April 1961. It was a bright spring day in Moscow. Life, simple and measured, took its course.

But what was that? Suddenly for a moment all radio stations in the world went off the air, the entire globe went quiet and froze.

"In the Soviet Union, the first spaceship in the world, 'Vostok', with a man on board was launched into orbit around the Earth," Moscow, the Soviet capital, solemnly and jubilantly announced to the entire planet. The cosmonaut in charge of the spaceship "Vostok" was the citizen of the USSR, Major Gagarin Yurii Alekseevich.

And the world came to life again, triumphantly, admiringly, rejoicing: "Done it!"

"A Soviet man in space!" — a medley of voices, in every language of the world was heard on the radio stations of both hemispheres.

"A great achievement in the history of mankind!"

"A triumph of the human spirit!"

"The beginning of a new era!" — these and other reports filled the extra editions of newspapers.

And the quiet, confident voice of Moscow continued to speak about the new era in the development of mankind, opened up by the Soviet Union, the country of victorious socialism ...

"To me, a simple Soviet man," said Yurii Gagarin, "a young communist, fell the great honor of being the first in the world to realize an age-old dream of mankind: to effect the first flight into outer space.

"It is a comforting thought that the first space flight is the merit of our Soviet people. Many people, commenting on this flight, called it 'unbelievable,' 'fantastic,' 'surprising.' No — it is only logical; this is just another victory of the social system which works for a wonderful future for all mankind."

Yes, on that memorable April morning the dream of all people came true: for the first time in history, man entered outer space.

During the historic minutes when the spaceship "Vostok" was being prepared for launching, and then during its flight with the first cosmonaut in the world, Yurii Alekseevich Gagarin, on board, two-way radio communication was maintained between the Earth and the spaceship. The clear, laconic, confident communications already belong to history, but they will forever remain a testimony to the great victory of Soviet man. Here is the dialogue of the last five minutes before the launching:

"Vostok" takes off.

Dawn: Alert 5 minutes.

Gagarin: Roger: 5-minute alert announced.

Dawn: Everything proceeding normally. Take up the initial position for registering physiological functions.

Gagarin: Roger. Everything proceeding normally; initial position for registering physiological functions to be taken up. Position taken.

Dawn: Roger.

Dawn: One-minute alert; can you hear me?

Gagarin: Roger: one-minute alert. Took up initial position.

Dawn: Roger.

Gagarin: Roger. I'm in good spirits, feeling well, ready to start.

Dawn: Excellent.

Dawn: Start!

Gagarin: We are off! .. Everything is going normally; I am feeling well and in good spirits; everything is normal.

Dawn: We all wish you a good flight; everything is normal.

Gagarin: So long, see you soon, dear friends!

Dawn: So long, see you soon!

The first cosmonaut in the world, Yu.A.Gagarin

Man's first flight in space was comparatively short. Yurii Alekseevich Gagarin flew once around the Earth in 108 minutes. However, this was the first step in the subjugation of space. Yu. A. Gagarin's feat represented everything that enriches man's life: humanitarian ideals, faithful love for one's homeland, inspiration to creativity, and unshakable faith in the unlimited possibilities of man in subjugating the forces of nature.

With his unique flight Yurii Alekseevich Gagarin began a new series of eminent records of the inhabitants of the Earth. He opened a new page in utilizing the rich possibilities available to mankind. It is with good reason that Gagarin's flight was registered as the first world record in the conquest of space. Here is the "card of general information which was submitted to the International Aeronautical Federation as a document proving the establishing of a new record.

CARD OF GENERAL INFORMATION

1. **Records:** length of flight, altitude of flight and weight.
2. **Pilot:** Gagarin Yurii Alekseevich; sports certificate No. 525/5; certificate issued on 16 December 1955.
3. **Nationality:** citizen of the USSR.
4. **Type of craft:** rocket-propelled.
5. **Make of craft:** "Vostok."
6. **Brief description of the craft:** the craft consists of a carrier rocket and a satellite vessel. The vessel has a pilot's cabin with observation windows and portholes, in which the pilot and the equipment are situated, and also an instrument section with the controls, together with the braking equipment.
7. **Identification markings (brief description):** "USSR — Vostok."
8. **Number and date of issue of the flight form:** form No. 3 of 25 March 1961.
9. **Engines installed in the craft:**

a) Type: liquid-fuel rocket engines.
b) Make: "Vostok."
c) Power: total maximum effective power of engines of all stages — 20 million horsepower.
d) Number of engines: 6.

V. A. Plaksin
I. G. Borisenko
Sports commissars of the Central Aeroclub of the USSR im. Chkalov

One of the most significant data recorded on the card was the power of the engines: 20 million horsepower. That had never been heard of before. Such a thrust was made possible by the new Soviet rockets which helped the "Vostok" to attain cosmic speed.

So far we do not know the names of the creators of the miraculous vessel and rocket, but the Party and government, on the day of the first space flight, acclaimed the great victory of the mind and labor of all the scientists, designers, technicians, workers, and all the teams and organizations which took part in the realization of man's first space flight.

During the solemn minutes of the launching of the spaceship "Vostok," many specialists who prepared the rocket for launching preserved their impressions for posterity. It is impossible to read these documents without being thrilled. This is how the engineer and inventor L. Mar'yanin described that moment:

"Early in the morning prepations for the start of the rocket began. It was already getting light. The sky was clear. The weather promised to be beautiful. The final checks were made.

"The initial preparations were conducted exactly in accordance with a previously stipulated graph. At last everything was ready. The carrier rocket was fueled.

"Yurii Gagarin took up his place in the spaceship perfectly relaxed, and as soon as radio communication had been established with him, he was pert, witty, and gay. One could feel that he wanted to be off as soon as possible into space.

"The order was given: 'Close the hatch of the spaceship!' At that moment my heart was in my mouth. The mechanics who carried out this operation, later said: 'We were shaking with excitement. After all, we did not lock in Strelka and Belka, but a man.' Taking leave of the cosmonaut (he was still without gloves) and wishing him a good flight, the mechanics quickly closed the entrance hatch.

"The hands of the clock moved slowly; two or three minutes remained until the start. Everyone heard his own fast heartbeat. In the operation building absolute quiet reigned. Only some operators occasionally reported with muted voices on the state of their systems. A short calm conversation between the chief designer and Yurii Gagarin took place. Everything was going normally and well.

"The last seconds passed. The order to prepare for launching was given. It was somehow difficult to breathe; one's lips were dry. The brisk order came: 'Start!' The starting knob was pressed down, for several moments various colors flashed on the light panel; orders and operators' reports could be heard.

"Gradually the roar of the engines increased. It already drowned out every other sound. As if a hurricane raged with increasing fury, thunder roared constantly. Finally through the din one could hear the operator reporting excitedly: 'Ascent effected!'

"Under the rocket a huge flame roared. The thrust increased quickly. The rocket rose, and then slowly, as if hesitating, it began its legendary flight into space with the first human being, the Soviet citizen Yurii Gagarin on board. The mighty roar was heard far and wide. The Earth shivered as the rocket gained speed.

"Gagarin's loud, cheerful voice boomed: 'We're off!' And the receding vessel was followed by the warm and heartfelt wish of the chief designer: 'See you soon!'

"'A bright, warm spring sun is shining!'"

No less interesting are the reminiscences of the commander of the military rocket unit to which was entrusted the launching of the spaceship "Vostok."

"For me, a soldier of the rocket forces," he wrote, " it was especially pleasant and joyous at that notable time of the first flight of a Soviet citizen into space to recall events connected with the preparation for the unique journey of Yu. A. Gagarin. A high honor was bestowed on us, to prepare the excellent spaceship 'Vostok' for launching, and then to actually launch the rocket.

"I may say with special satisfaction that the Soviet space rocket is a veritable miracle of modern technology. It seems to be a fantastic spaceship for the future. Its engines have enormous power, exceeding the combined power of all the power stations of such countries as Sweden and Norway together. The engines of this rocket operate at high temperatures, and therefore cooling systems were devised, heat-resisting alloys produced, and effective control devices envisaged.

"We, the rocketeers, also had to devote much work and creative ability to the careful preparation of the 'Vostok' rocket and spaceship for launching. After the dates and tasks of the launching had been fixed, a Party meeting was held in our unit at which the soldiers spoke with pride and understanding of the task entrusted to us. The communists promised to do everything to ensure that the launching and flight of the vessel would be a success and that the equipment of the rocket vessel would work faultlessly.

"And the work absorbed us all... The instruments and systems were checked and tested. All mechanisms and automatic devices were tested according to schedule and under conditions which might occur during the ascent of the rocket or the launching of the vessel. The reliability of the main, auxiliary, and alternate systems was checked repeatedly. All our equipment performed strictly according to our calculations...

"To the end of my days I will remember the sunny morning of 12 April 1961. Yu. Gagarin arrived, and, accompanied by the chief engineer, went to the lift. They were taken up to the crew's platform by lift. Yurii Alekseevich turned around once more and greeted all those accompanying him; he raised his clasped hands and waved to them with the words: 'Let us soon meet again!'

"Everyone greeted him with applause. This was a solemn moment. A lump rose in our throats at the realization that very soon our comrade would penetrate outer space, and the whole world would hear about the great achievement of the Soviet people. The lift had taken him effortlessly to the top, and stopped at the entrance to the cabin of the space vessel. On the ground everyone quickly went to his assigned place. No one was left on the platform. The loudspeaker counted the minutes remaining until launching. At the control point everything stopped in anticipation of the imminent event. The officers at the panel attentively observed the many instruments and glass plates of their various systems. Reports followed one after the other. The commander of the launching crew reported to the technical management that he was ready, and asked for permission to launch.

"A hand was slowly placed on the knob marked 'Launch'. The last seconds passed, and the knob was pressed. The rocket, literally resting on a great jet of flames, shivered and then rose, slowly at first, and then faster and faster. We were moved to the depth of our souls by what Gagarin said over the radio at that moment: 'We're off!'

"So simple and valorous! We knew better than anyone how much self-control and boundless faith in the work of the scientists and his fellow-rocketeers was necessary for him to behave so calmly and confidently.

"We saw on the television screens how the cabin was lit up by the sun which shone through the portholes. Yurii Alekseevich smiled and exclaimed: 'Oh, how beautiful!'

"Then he turned his head toward the television, and began to describe in detail his physical state, the G-force, the separation of the rocket stages, and the operation of the vessel's systems. We all listened with bated breath to the report of the first cosmonaut."

A Soviet man was in space! This great victory of the intelligence and heroic work of the Soviet people, thrilled the whole world. After a few minutes, the words "Vostok" and "Gagarin" became the most popular words in all the world's languages. At this hour the attention of the entire planet was riveted to our homeland.

The boundary of the unknown recedes far away in space. Interplanetary and interstellar space will be crossed by new spaceships guided by emissaries from the Earth. But mankind will remember forever this immortal feat of the Soviet people and its valiant son Yurii Gagarin; never will he be overshadowed by new achievements of people, no matter how great.

The National Artist of the USSR, the painter A. Gerasimov, called Gagarin a stellar Icarus and sent him a glowing message:

"Dear, glorious Icarus, soaring above the world on the wings of the wondrous legend! Today I thought of you.

"You were not born there, Icarus. You did not make your wings from this material — not from this Earth did you start for your flight. Did you know that there is a Russia on the Earth, and that it is inhabited by people who first invented seven-mile boots and the flying carpet, and then made a column that reached right up to heaven? They, like you, were great dreamers. They also dreamed of conquering the sky. But before they went out to conquer space, they stormed the Winter Palace, the refuge of those who bound their hands and souls. And then, spreading their powerful wings in freedom and introducing a new order on Earth, they went to conquer the sky.

"And they were victorious too!

"You can well envy them, proud and valiant Icarus! ... Today the ultimate dream of the courageous came true: a descendant of those who in their wondrous dreams built a column as high as the sky, the proud and valiant Soviet man, leaving his native Russian soil, stayed in the sky, saw at close range the enigmatic stars and the legendary Luna, and returned home safely and soundly.

"I wonder: is this not a dream?... I have lived on the Earth for eighty years; I have seen all sorts of things in my life; I always believed in the genius of my people. Wonders of wonders have happened in my time; what

were once fairy tales are now a thing of the past. But what has been achieved now, that cannot be told in fairy tales nor described on paper.

"Glorious far-away Icarus! Do you want me to divulge to you the secret of the success achieved by the Soviet cosmonaut Yurii Gagarin?

"The wings of your valiant Soviet colleague are made from other material. They were forged by reliable blacksmiths according to drawings and designs of a genius whose name is Lenin."

The following poem was dedicated to Yurii Gagarin by the poet and airman Ivan Shamov:

You faithful disciple of my friends
You grew up in the Soviet land.
And in a deathless flight into space
You carried the flag of our homeland.
There among the stars, in bottomless fog
You smilingly sang a song;
Thrilled by your smile
The whole world grew younger on that day.
It's April again!
And on this day
Remembering your flight, Gagarin,
Russia's First Soldier,
The whole world shakes your hand.
Let us attack the universe!
Let dawn arise again!
And let your fellow heroes
Follow in your wake!

Hardly four months had passed after the legendary flight of Yurii Gagarin, and mankind again heard thrilling tidings. On 6 August 1961 a spaceship called "Vostok-2," piloted by Gherman Stepanovich Titov, was launched into space. Within 25 hours 11 minutes the vessel traveled seventeen times around the Earth, and covered a distance of 703,143 km. G. S. Titov's daylong flight provided science with unassailable proof that man can stay in space for a considerable time.

The heroic cosmonauts Yurii Gagarin and Gherman Titov blazed the trail on the cosmic highways, and after them followed Andriyan Nikolaev and Pavel Popovich, Valerii Bykovskii, and the first woman cosmonaut in the world, Valentina Tereshkova into the still mysterious outer space.

Flights of several cosmonauts together suggested the dispatch of entire scientific expeditions into space. In these flights the possibilities of a planned approach of two spaceships toward each other, the establishment of radio communication between them, and also highly accurate simultaneous landings in a specified area were tested.

After that yet another matchless page was added to the history of mankind's struggle to conquer outer space. The Soviet emissary, the spaceship "Voskhod" with three people on board, successfully carried out its research program. Manning the first multiseat spaceship in the world were the pilot and cosmonaut Vladimir Komarov, the scientific worker Konstantin Feoktistov, and the physician Boris Egorov.

Our cosmonauts performed yet another feat. They literally opened the door into space! Aleksei Leonov, guided by Pavel Belyaev, effected the walk in space from the satellite "Voskhod-2."

All these flights completed the first stage of a grandiose program of scientific investigations aimed at studying the effect of the conditions prevailing in outer space on the human organism. Science obtained a mass of experimental material.

The first woman cosmonaut in the world, V. V. Nikolaeva-Tereshkova.

At the same time everyone became convinced of the reliability of the Soviet rockets and of all the systems involved in space flights.

The modern powerful rocket engine is certainly a rare wonder. It develops a colossal thrust of hundreds of tons. To produce such a huge thrust, the engine burns an exceptionally large amount of fuel. In its way this is also a present-day miracle — one which has been achieved by Soviet chemists. In addition to this, the engine is provided with complicated and perfect automation gear which ensures its reliable operation under conditions of high temperatures and pressures, vibrations, and inertia overloads previously unknown. Even a routine bench test of such an engine presents unique problems on account of the size and complexity of the undertaking. It is quite an engineering feat.

High reliability is the guideline not only of the engines but of all the Soviet space techniques. Under the conditions of space flights, the failure of any one of the thousands of components of the rocket could jeopardize the entire flight. Space technology is therefore exceptional in its reliability requirements. If, for instance, the reliability of one component of the rocket is 0.999 (i.e., that no more than one such component out of a thousand will fail), even so 7 or 8 out of every ten rocket launchings can fail. The exceptional reliability of Soviet space technology testifies to its high standard.

Finally, the unrivaled accuracy of the rocket guiding systems characteristic of Soviet space technology, must be mentioned. This accuracy has been demonstrated to the whole world more than once, both in contemporary rocket flights and in experimental launchings of rockets in the area of the Pacific ocean. In attaining this high accuracy, an important part is played by Soviet mathematics, radioelectronics, cybernetics, and telemechanics.

But of course, the Soviet people who are the creators and builders of powerful rockets, of all the variegated rocketry, and the valiant tribe of cosmonauts are the decisive factors in the Soviet space victories.

The socialist system which had its beginning in October 1917, produced such men. Some old Bolsheviks, expressing their delight in the feat of Andriyan Nikolaev and Pavel Popovich, wrote in "Pravda": "When our

spaceships 'Vostok-3' and 'Vostok-4' completed their heroic flight into the regions of the stars, in their flight, in the sound of their calls, we heard the rumble of the barricades of the year five [1905], we saw the flames of the battles of the year seventeen and heard the industrious hum of the first Five-Year plans, the mighty advance in the building of communism. The struggle of generations for a better life bore wonderful fruit."

Yes! The continuation of the generations is in reliable hands. The new Soviet man, ruler of space and time, master of the atom and of the mighty rocket fire, confirms by his entire life his completely noble moral outlook, by all his deeds the great power of the famous revolutionary traditions, bringing nearer the triumph of the communist ideals throughout the world.

The Soviet people are rightly proud of their space rocketry and the host of valiant cosmonauts who gained undying fame for their homeland. They are also proud of their military rocket hardware, the excellent global rockets, and the famous rocketeers in the armed forces who stand firmly, vigilantly guarding our socialist homeland.

OUR FORMIDABLE WEAPON

"Attention! This is the sight and sound of Moscow!" — these words, broadcast every day, take on a special meaning twice a year, on 1 May and 7 November. On these holidays thousands of Soviet citizens and inhabitants of other countries are glued to their TV sets, watching units of the Soviet Army march past Red Square in Moscow, solemnly and in perfect order, equipped with first-class weapons.

Students of academies, military schools, and Suvorov and Nakhimov schools march past the grandstands in straight lines. Behind them armored troop carriers with infantry pass in perfect lines, followed by light tanks and armored cars. Tractors, straining and rumbling, file past heavily with guns of various calibers.

Then comes the most interesting part of the parade — something that fills the Soviet citizens and their foreign friends with joy: rocket units enter Red Square.

This is how the newspaper "Krasnaya Zvezda" described one of the last May-Day parades at Red Square in Moscow:

"First come the tactical rockets, moving on self-propelled launchers. They are distinguished by their great power and highly accurate fire. They are followed by various classes of rockets designed for different purposes, capable of destroying the most modern aircraft with their first or second shot. Units of tactical and tactical-operational rockets on self-propelled launchers pass in straight lines. Various echelons equipped with rockets carrying nuclear warheads of great power and range constitute the main strength of the Soviet forces.

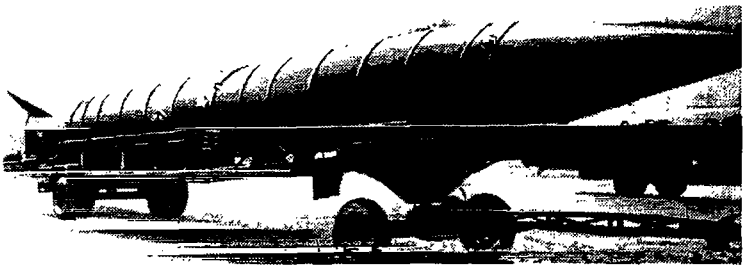
"For the first time we see on Red Square the new powerful weapon — twin rockets mounted on self-propelled launchers.

"Today the unit of long-range pilotless interceptors participates again in the parade. Experience in mastering rocket techniques and in target practice in the armed forces proved the absolute reliability and great combat potentialities of these rockets for destroying any contemporary means of aerial or space attack.

"The formidable long-range rockets of the glorious submarine fleet are now on the square. These rockets can be launched under water and can hit enemy installations in the depth of any continent with their powerful nuclear warheads.

"Units of the Strategic Rocket Forces, the main nuclear rocket force of the country, now move forward in columns."

It is thoroughly clear to every spectator that the successes of socialist production, and of Soviet science and technology permitted the Soviet people to equip their army with the lastest weapons.



A ballistic missile in the parade.

Soviet scientists, engineers, and military specialists, utilizing the highly developed Soviet economy and the achievements of science, have attained great successes in the field of armaments. Within a short time the Soviet Army was completely rearmed. The forces received jet aircraft, new types of tanks, and different rockets for the most diverse purposes.

Now the armament of the army and navy includes nuclear and thermonuclear weapons of varying power, intercontinental and global ballistic missiles, nuclear-powered submarines supplied with rockets, jet fighters, bombers, rocket carriers of great speed and range, and other powerful arms.

The appearance of nuclear weapons and their main carriers, rockets, and also the introduction in the Armed Forces of radioelectronic and jet-propulsion techniques and nuclear power installations have led to many changes in the Armed Forces.

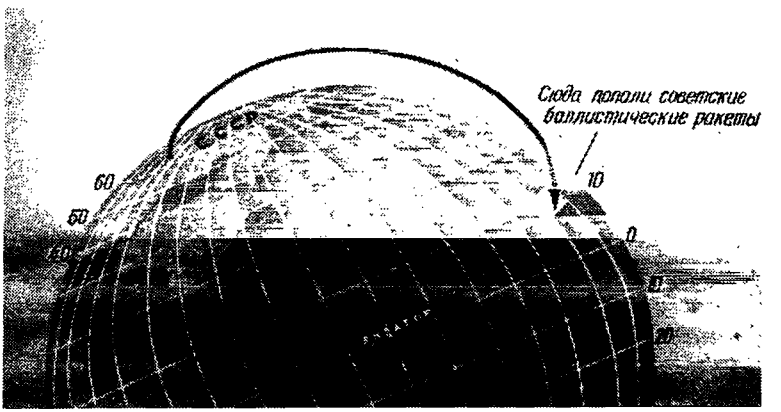
The Strategic Rocket Forces have become the most important of the rocket and nuclear forces of the Soviet Union. The country supplied them with the most powerful nuclear missiles and the fastest rockets with the longest range, including intercontinental and global missiles, because of the importance and the nature of their work. These rockets are capable of conveying very powerful missiles within a few minutes over enormous distances to deal the enemy crushing blows.

The Defense Minister of the USSR in his speech at the 22nd Congress of the CPSU quoted data from an official document of the US Congress which said that in the initial phase of the war important targets in the United States of America could be attacked with 263 thermonuclear blows, each equivalent on the average to 5 megatons of TNT. As a result of these attacks 132 major targets would be destroyed as well as 71 cities; half the territory would be contaminated; and almost one third of the population would perish.

In the opinion of the Western specialists themselves, the security of other countries, particularly the members of NATO with their small territory and dense population, would be threatened even more under the conditions of rocket and nuclear war. It was calculated abroad that to put West Germany, for example, out of combat, no more than 8 missiles, each of 5 megatons, would be required.

To this can be added only that the Soviet Union has missiles of much greater power (up to 100 megatons). In addition, the Soviet ballistic

missiles have performed so well that no one can doubt their ability to strike at any point on the globe. At the 22nd Party Congress it was reported that practical combat launchings of rockets by the rocket forces in 1961 yielded convincing results: of all the launchings at medium range more than 90 per cent were classified as "excellent" and "very good," and all the intercontinental missiles were rated in these two categories.



Tests of the powerful Soviet ballistic missiles.

The Soviet scientists developed three very important combat qualities in the rockets: unlimited range, enabling them to strike the enemy regardless of his territorial (geographical) position; huge power of the nuclear or thermonuclear warhead, ensuring that any military objective would be destroyed by a single blow; and practical inviolability in regard to existing systems of antiaircraft and antirocket defense.

Another great advantage of rockets over other weapons is their independence of climatic, geographical, and meteorological conditions, and of the time of day or season of the year. The rocket weapon became the chief weapon of all the branches of the Soviet Army because of all these positive qualities.

Rocket units with operational and tactical assignments, equipped with nuclear and other rockets of ranges varying from a few to many hundreds of kilometers, have now become the main arm of the Soviet ground forces. Since these forces have had the rockets at their disposal, they have been capable of destroying any target or object lying anywhere within the combat zone. This greatly increased the combat power of the ground forces and widened the range of their combat possibilities.

The Soviet soldiers are devoted to the new weapon. They have expressed their feelings toward the modern weaponry in various ways. The following poem was dedicated to the rocket by a reserve officer, the young poet Vladimir Meshchenko:

Its structure is like the sweep
of our indestructible strength,
and the rocket seems to sing
with the loud voice of Russia.
It is only a thunderstorm.
Behold — in its mirror-like steel
the clear eyes of your beloved
all of a sudden flash.
It does not crave destruction.
But — like a sword over the enemy camp
it aims into the ghostly darkness;
like a sentry standing guard.

The importance of rocket-propelled nuclear weapons for the Soviet Army can hardly be overestimated. They make it possible to attack the enemy quickly and powerfully so as to decisively change the course of the fighting, enabling the ground forces — tanks, motorized infantry, and parachutists — in cooperation with special forces using rocket-propelled nuclear arms, to quickly annihilate the main enemy forces.

Because of their long range, rockets facilitate the solution of problems of maneuvering by fire and concentrating it in the decisive directions. Previously, before the ground forces had this powerful weapon at their disposal, in order to deal the main enemy forces a decisive blow, they had to concentrate the required number of troops secretly, place the units concerned in advantageous positions, and only then could they attack with all the firing power at their disposal, from rifles and submachine guns up to powerful large-caliber guns and mortars.

Thus the effectiveness of firing attacks on the enemy was dependent on many factors: the skill with which the maneuver was carried out, the element of surprise, and secrecy.

With the long-range rocket weapons in existence now, it is possible to fire at enemy troop concentrations chosen by the high command and at military objectives, regardless of their position, whether in the frontline or deep in the rear. Therefore, complicated maneuvers of troops and weapons are no longer necessary; it is sufficient now to carry out a maneuver by fire, or as it is called, a maneuver with trajectories. Formerly, to achieve supremacy in firing power at a certain sector of the front, it was necessary to shift numerous artillery regiments, brigades, divisions, and even entire artillery corps over hundreds of kilometers. It is now sufficient to aim the rockets differently in order to deal a crushing blow to any sector of the front or any area in the rear, and yet such a firing maneuver, despite its large scale, requires very little time.

One of the excellent qualities of operational and tactical rocket units of various echelons is their capability of moving at short notice by their own means over large distances without loss of combat readiness, and of deploying quickly after the march in order to launch their rockets. This has been incontrovertibly confirmed by rich experience gained in tactical maneuvers with the combat launching of rockets, carried out under different conditions of locale, in different seasons, during the day and at night, and in all types of weather.

The appearance of contemporary rocket-propelled nuclear weapons has radically changed the air force and the navy. The air-to-air missiles constitute a mighty attacking force of the rocket-carrying aircraft. The

weight of such an installation in a fighter plane is small, and since a rocket-propelled missile carries a much larger charge than a shell, the destruction of even the largest bombers is ensured.

Other missiles with which the air force is armed, for example, the air-to-ground missiles, are also a dread weapon — the weapon of the bombers.

Such missiles are provided with an engine, and are capable of developing great speed, independent of the speed of the aircraft launching them. The bomber, therefore, no longer needs to enter the zone of antiaircraft defense of the target; it has only to approach it — to convey the missile to a certain point. Obviously, under such conditions the vulnerability of the aircraft is considerably reduced.

Rocket carriers in the air.

The air-to-ground missiles are fixed under the fuselages and wings of the rocket-carrying aircraft. They have wings and superficially resemble fighter planes, but they are smaller. They can destroy the most diverse targets on the ground or on the sea.

The newspaper "Krasnaya Zvezda" described a flight of a modern rocket-carrier plane equipped with air-to-ground missiles as follows:

Two crews, called out on an alert, waited to take off. As long as they sat in their planes, the waiting was bearable, whereas when they were allowed to rest before taking off, nobody was able to fall asleep. The people were restless, waiting for the signal. Only as dawn broke were they able to fall into an uneasy, light slumber. And at that moment the command point ordered: "Take off!"

A reconnaissance mission awaited them. On the way Major Vladimir Leshkinov and the commander of the second crew exchanged a few words, and everyone took his position.

They found the Sun beyond the clouds, not because it had risen, but because the planes flew toward it as if it were a beacon.

It was difficult to realize that the airmen were flying over the ocean. The clouds covered the expanse of water like snow. Only occasionally was the white blanket broken by the green water, and then everyone recognized with a sweeping glance that there was a thunderstorm. The clouds again blocked out the ocean, grew, and forced the planes to fly even higher.

When the Sun's rays flooded the cabin of the plane again, Leshkinov's pale face, with somewhat swollen eyelids, was lit up by a smile.

"Navigator — course?"

"240. Wind getting stronger and changing direction."

"Plot the course with the greatest possible accuracy."

"Yes!"

Silence again. Only the turbines roared hoarsely, and now and again discharges from the ether were heard in the earphones. Leshkinov empathized with the operator: young, inexperienced, his first time on such a flight. For the navigator it was also difficult.

Indeed, the situation became more complicated for the operator. Some yellow spots flashed on the screen. Perhaps a target was indicated. But how could this be distinguished from many other similar fiery spots? He reported to the commander of the plane and to the navigator. The latter considered the time as well as the course of the target and concluded: no, an "enemy" craft did not succeed in penetrating this far. Nevertheless, he contacted the navigator of the six-plane formation. He, an experienced navigator, confirmed without hesitation: "No, this is not the target."

They crossed over to an island to get their exact bearings. From there they flew to the area of the search. And again they heard the voice of the operator, blurred, either because of his agitation or because of radio interference:

"Target in sight ... Distance ..."

Leshkinov was not in the habit of doubting reports, but now he could not contain himself, and he asked again: "Distance?"

The answer was repeated. Yes, at such a distance they cannot always determine the location. But then, one must believe people. The major transmitted the coordinates to the six-plane formation. There they were jubilant, and soon they themselves "caught" the vessel somewhere far away under the cloud blanket.

The "six" decided to approach the vessel in order to photograph it. It was necessary to fly lower. But how? The cloud cover, almost ten kilometers thick, hung over the water. And how high was it over the sea? Perhaps its lower fringe touched the waves? But there was no time for guessing. The "six" plunged into the soft mass.

The vessel was discovered. But how could it be approached? It would certainly put up a barrage of fire. All its antiaircraft defenses would be put into operation, even missiles. The scouts found a good solution: they flew at the lowest possible altitude. Piloting was difficult. Control of the aircraft became more complicated. On the other hand, surprise was thus ensured.

The vessel was visually sighted. Photographed. The "six" began transmitting to the command point...

Time was getting short. The crews set course for the return. The tropopause changed frequently, and it was now difficult to estimate how

long the fuel would last. To avoid an error in calculation, they rose higher and higher, as the fuel was being spent. The stratosphere is exhausting; piloting requires greater attention. The starboard and port pilots relieved each other from time to time.

On the return flight, they met the assault group. It flew in close formation at great speed. As if to hurry their comrades-in-arms who rushed along anyway, they again gave them the coordinates of the target.

The anxiety over the fuel was not unwarranted. During the circling by the four-plane formation the signal lamp already lit up: only half an hour's supply for the turbines remained. It was necessary to touch down without the traditional landing maneuver.

In the meantime, their training became intensified. The assault group was led by a seasoned aviator. The commander of the fire emplacements of the lead plane reported:

"I see the first approaching... I see — the second..." The last plane lined up.

The tight-knit formation presented an imposing spectacle. With roaring engines the armada swooped down over the sea, wingtip to wingtip, under the cloud canopy.

An impressive spectacle. But its participants were not thinking of beauty. The sea is beautiful for those who walk along the shore, but here there was work to be done. The command point ordered:

"Work at nine fifty-eight minutes thirty seconds."

To carry out the attack exactly on time required calculation, endurance, and coordination. The leader watched the formation on his right with apprehension. It was not easy to keep in formation. Things were especially difficult for the third plane in the file. It was not simple to attain, and even more difficult to maintain the distance equal to that between the first and the second planes. But the planes flew, as if screwed together in one flying and roaring formation. Only rarely was it necessary to warn:

"Do not crowd!"

"Keep away ... stream..."

Difficult. All sorts of things happen in the air. During the previous flight things had gone wrong in the plane of Captain Tychina. The captain had proved to be cool-headed. Now Tychina had returned to the formation. His plane flew tranquilly, straight, as if the recent troubles had not existed.

One can imagine what it cost the captain to maintain his serenity. The second pilot occasionally glanced at his commander and noticed a vein swelling at his temple. His face was pale and bathed in sweat. It was not because of the heat. On the starboard and port sides were the silvery wingtips of the planes flying next to him. Every meter counted.

The lead planes could not see how the last planes were faring. They would have liked very much to have a look, but they had to be satisfied with the reports of the gunners. Captain Sreznikov replaced a comrade who fell ill suddenly, and for the first time took up the position of flying on the side. He held his own well.

Descending clouds kept the planes low above the water. To fly any lower would be risky. At a command the roaring monsters soared into the cloud bank nose-first, and flew right through it. Like glowing cigars the signals moved across the screen of the ground radar. To the observer it seemed as if they crawled across the screen as in a slow-motion film.

The minutes also seemed to drag on the return flight of the planes through the clouds. During the run on the target a new obstacle emerged... The formation split into two, but as soon as it had passed the defense screen it united again.

After a few minutes a new "barrier" arose. This time it was one that could not be bypassed or avoided: rain poured down. Oblique streams of water obscured the windshields. It became strangely dark. The lead pilot viewed the formation. Flying in line, with only small parts occasionally protruding, the machines appeared as blue silhouettes, and as if sensing the imminence of a fight, seemed to close ranks even more tightly. The flight commander felt a thrill, so well-known only to him. He wanted to call: "Keep it up, comrades! The target is near." At that moment the resounding voice of the operator came through:

"I see a vessel. The distance..."

Timakov addressed the crews:

"This is 'Flint' The order is..."

The rockets were lowered.

"This is 'Flint'. The order is ..."

The moment of the attack! A fiery trail emerged from the exhaust nozzles. It evaporated the rain clouds and light broke through. In another moment the thrusting rockets would leave their holders and would streak irreversibly toward the target. Over the ocean the screech of torn metal would spread. The vessel, torn in half, would exhale a flame many meters high, and enveloped by heavy waves it would sink.

The attack took place at nine fifty-eight. Exactly on time. This fight was observed by representatives of a higher command. Following the rocket carriers with his eyes as they disappeared over the sea, one of them remarked briefly and simply: "Excellent!"

This is how present-day air-borne rocket carriers work. The sailors are not outdone by the airmen.

Submarines designed for various purposes constitute the main force of the navy, and nuclear submarines are the basis of the submarine fleet. With regard to their combat potential, modern submarines armed with rockets are immeasurably more powerful than the submarines of the Second World War. Soviet submarines today have a practically unlimited range, and can stay submerged for any length of time. They are capable of quickly traversing a huge expanse of water, even under the ice of the Arctic region, and they do not have to sneak up close to their target. These submarines are highly maneuverable and well-concealed rocket carriers. It is not difficult to imagine the effectiveness of such boats in the event of nuclear missile war unleashed by the aggressors.

The introduction of rocket weapons in the Soviet Navy also gave rise to new types of surface vessels. The Soviet Navy now incorporates excellent rocket cruisers and missile boats. If we compare them with their predecessors, cruisers armed with conventional artillery and torpedo boats, we find that their combat potential and firing power have been increased tremendously.

It is known that at present the navy is armed with two types of modern missiles: ballistic and homing. This results from an anticipation of the

nature of future combat actions which might be necessitated by aggressive attack against the Soviet Union, and of the fighting tasks which confront the Soviet Navy.

Ballistic missiles are primarily intended for destroying enemy shore targets, such as naval bases or industrial centers. However, it must be realized that if the aggressors unleash war against the Soviet Union, they will be forced to cross large expanses of water and to make extensive use of sea transport. Perhaps the Soviet Navy will be faced with the task of destroying enemy boats and ships in the sea. Homing missiles are the most effective weapon for fighting on the high seas. As such a missile approaches its target, it is guided by its own instruments to hit the target and destroy it. The Soviet vessels armed with homing missiles are capable of destroying enemy ships and boats, especially aircraft carriers, in the sea hundreds of kilometers away.

Even now the sea-borne rocket carriers are learning to launch crushing attacks.

Far out at sea, night is quickly falling. Heavy clouds obscure the sky, and the wind is unable to dispel them.

"Our missile boat," says Captain 3rd Class M. Agafonov, "has been at sea for several hours already. A cruel swell rocks the vessel from side to side, but the sailors are calmly on guard."

The purpose of this voyage is a practical launching of rockets at night. This is an assignment that would be difficult for any crew, and on this ship there are many young rocketeers. Will they be able to do properly all that is required?

This question occupied the military command as well as the political department. They even sent me on the boat to help if it should become necessary.

The commander, a captain 3rd class, met me with a smile: "We do not reject assistance, but we do not doubt our own capabilities."

He was not boasting. He knew his men and their training. Every man on the vessel knew exactly what he had to do.

Before the rocket carrier put to sea, a plenary meeting was held. Its resolution was brief: "to fulfill the task excellently and to challenge the other vessels to socialist emulation." The combat sheets mentioned the individual obligations assumed by the sailors. This indicated the work of the Party cell. Although there were few communists on the boat, they not only explained the commander's orders to every sailor, but also personally exemplified by their deeds how to fulfill them.

The ranking member of the launching crew and Party organizer Midshipman Chiyanov did not let go of the control and measuring instruments even for a moment. He thoroughly checked the reliable functioning of the equipment. The midshipman had 25 years of service to his credit; he was experienced in battle, but even he was flustered.

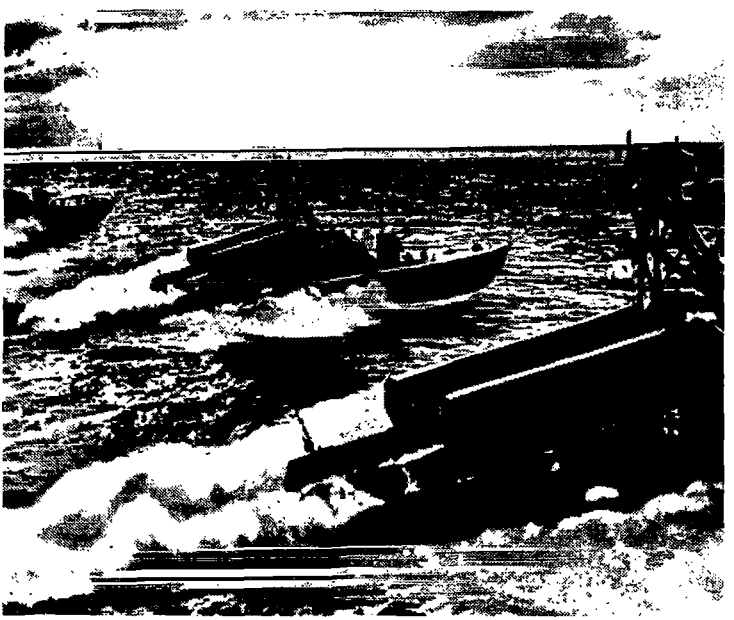
Chiyanov had not been serving long on the rocket carrier. He had sailed many miles during his long service, but in recent years he had been on shore. However, the sea attracted him. Eventually his insistent applications succeeded — the midshipman was transferred to the rocket carrier.

It is difficult to start from the beginning at a ripe age, but that is the only way of becoming a rocketeer. It was strange to see a young petty

officer teaching the mature midshipman. But Chiyanov was unconcerned with the source of his knowledge. As long as that knowledge was sound.

The midshipman progressed surprisingly quickly. For his diligence and his love of people and machinery, he was elected Party organizer on the vessel. He took upon himself another task in his service: the Party leader also had to be the best soldier. He attained his aim. This launching was to be his examination.

Midshipman Chiyanov was not the only one who advanced so quickly! Consider Lieutenant Kulinich. A few months after graduating from school, still in need of experience and knowledge, he was required by life to become a full-fledged commander immediately.



Missile boats.

In Kulinich's unit there were sailors with the most variegated training. Some of them knew rocketry fairly well; others had hardly come in contact with it. Even Midshipman Samokhvalov had only recently acquired some knowledge of it. Until then he had been a wireless operator.

Lieutenant Kulinich did not stint the hours of teaching his subordinates. He also spent many an evening with Samokhvalov. It happened one evening that the officer sat down behind the control desk and step by step showed the midshipman how to prepare a rocket for firing. These unplanned lessons continued for some time. The officer's patience and Samokhvalov's diligence bore fruit. The good wireless operator became a good rocketeer.

Before the voyage Midshipman Samokhvalov submitted an application to the Party organization asking to be considered for membership in the CPSU.

"I have been thinking of this for a long time but I did not have enough confidence in myself," he said. "Now is the most suitable time."

And the rocket carrier sailed through the night. From under its keel a luminous wake emerged: the phosphorescent sea.

The radiometer operator Petty Officer 2nd Class Ivanenko was calm as he kept a constant lookout for the target. He was a first-rate specialist. Soon the target appeared on the screen in the shape of a pulsating point. Immediately the commander's voice: "Rocket attack!"

Midshipman Chiyanov completed the preparations of the rocket for launching. Petty Officer Ivanenko worked out the combat course; operator Samokhvalov prepared the launching circuit. And then came the final command.

A red flame enveloped the boat. Framed by the square window the agitated sea resembled a picture. And then everything sank into darkness again.

Lieutenant Kulinich rushed to the bridge. "Well done!" he cried enthusiastically.

The fiery rocket cut through the darkness and flew just as intended. The sailors felt joy in their hearts.

The boat then dashed toward the target like a hurricane. There it was. A searchlight beam probed the darkness. A huge hole gaped in the side of the vessel.

"It would be interesting to know what kind of hole a warhead would have made," somebody remarked.

"I think we would not be able to see the target at all then," said the helmsman Petty Officer 2nd Class Demchenko.

The Soviet Union was able to perfect the means of attack and the means of defense harmoniously, utilizing the great development of both her economy and modern armaments. At the 22nd Party Congress it was noted that the Party devoted particular attention to antiaircraft defense. Even abroad the quick progress in this field had to be acknowledged. As late as 1961 the foreign press remarked that in the Soviet Union "improvements in radiolocation, antiaircraft defense, and high-altitude interceptor planes" can be observed.

After the 22nd Party Congress the development of Soviet AA defense was further intensified. In the USSR it is now based on the power of the anti-aircraft rocket forces which work in close cooperation with the new fighter planes. The antiaircraft defense forces now receive first-class equipment. Not only have the rocket weapons of the ground forces been improved, but also the air-to-air guided missiles which have become the reliable "fiery sword" of the Soviet interceptors. Supersonic speed and great maneuverability of the aircraft, together with great firing power and exceptional accuracy of its rockets made the aircraft capable of hitting various air-borne targets infallibly. Simultaneous action of rocket-carrying interceptors and antiaircraft rockets ensures that air-borne targets are destroyed at a safe distance and at any altitude.

It is obviously in this context that the American press wrote about the cutting down in the production of strategic bombers. "Bombers," wrote one paper there, "are doomed to a slow death. This decision is based on the growing efficiency of the Soviet air defense..."

Military circles in the West follow the success of the USSR in rocket construction and the building up of its defenses against rockets with minute attention. A huge impression was made abroad by the Soviet long-range pilotless interceptors, first exhibited at a military parade on 7 November 1963. These long-range antiaircraft rockets are capable of destroying any means of air or space attack.

All these new weapons were successfully tested at Soviet firing ranges. It is certain that in the actual fighting they will prove very effective and will not fail. An indication of this was the destruction of a spy plane on the morning of 1 May 1960 in the Sverdlovsk Region. Let us recall how it happened.

After the alert had been given, the second hand had hardly moved before every soldier had taken his position: at the radiolocators, control desks, and launching devices. The weblike metal aerial of the locator station began moving. Describing a gigantic cone, it continuously emitted invisible radio impulses and sensitively probed the entire aerial ocean over a distance of hundreds of kilometers.

The rocket forces confidently operated complicated radiolocation equipment. From the control lamps of different colors on the instruments they determined the correct working order and preparedness of the station. They attentively watched the screen of the indicator. All their thoughts, attention, and endeavors were concentrated on one focus.

Suddenly a speck of light appeared on the grayish silvery background. At the same moment the excited voice of Sergeant Vitalii Yagushkin was heard. He reported to the officer: "Target sighted!"

On the sparkling screen, the speck of light grew more and more distinct. In the language of operators this means "indication of target."

Several seconds passed and to the well-trained radiolocation operators it became clear that the plane was flying in the stratosphere at a speed of more than 700 kilometers per hour. It changed its direction and height. But in spite of the clever maneuvers, the beams of the radiolocator held the metal bird in their invisible grip.

It only remained to find out who was in the stratosphere — a comrade-in-arms or a foreigner coming with insidious intentions?

The operators had to answer this question precisely and unerringly.

To puzzle that out, or rather to decipher it with the aid of radiolocation was not overly difficult. The operators emitted short radio signals into the ether, like questions. They knew that the answer would arrive soon, and that if the aircraft was their own, the radio operator would reply in a specific code. On the locator screen, too, a recognition signal would appear, meaning "Ours."

Some wearisome seconds passed. Quite some time had elapsed already but the aircraft did not reply. It continued traversing the air space of the Soviet Union at great speed along the chosen route.

"Some foreign bird has come flying to us," said Sergeant Yagushkin as if to himself, with anxiety in his voice, and quickly reported it to the commander. He also told his assistants: "Keep a careful track of the intruder."

The guidance station worked reliably. The operators, all of them trained specialists, confidently manipulated their complicated apparatus and kept a precise track of the discovered target.

The commander of the squadron, Major M.R. Voronov, was also watching the screen attentively. When the plane suddenly changed its course, he ordered loudly: "Target to be followed vigilantly!"

"Aye, aye," the operators replied and watched the screens even more carefully.

The aircraft came closer to the boundary of the aerial zone of the rocket unit. As the minutes passed, the tension grew. The men's faces showed their great anxiety. Every ounce of willpower was summoned, and it helped to suppress the excitement.

M. R. Voronov.

At that time Captain Nikolai Ivanovich Kolosov worked confidently and with concentration at the firing position. Under his leadership the platoon of Sergeant Fedorov had prepared the rocket for combat. The launching crew worked accurately and confidently, checking and double-checking the preparedness of the launching equipment.

After the captain had made sure that all the automatic gear of the launching equipment worked faultlessly, he gave the order: "Crew, take cover!"

The most decisive minute of the fight began...

One second, two, three seconds...

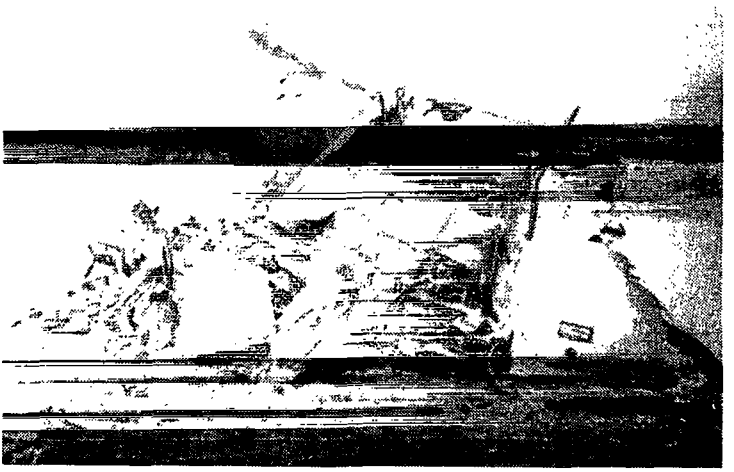
The intruder aircraft crossed the invisible frontier of the aerial zone. Major Voronov gave the order to open fire. He calmly and firmly pronounced only one fateful word: "Fire!"

First Lieutenant Eduard Fel'dblyum pressed the knob of the automatic gear with determination. On the control panel with its variety of instruments a red lamp lit up. Every one was quiet. The tension reached a peak. That was not difficult to understand. After all, the squadron had practiced combat firing many times, but this was the first time it fired at a real enemy.

Another moment passed, and then the silvery cigar-shaped metallic missile rose above the launching gear. A blinding flash of fire emerged from its tail with terrific force. Above the taiga forest the mighty roar of its rocket engine sounded like thunder. Spewing flames, the missile streaked away into the stratosphere.

The officer of the guiding system Eduard Fel'dblyum, the Party group organizer Lieutenant Nikolai Batukhtin, and all the operators intently watched the supersonic flight of the missile on their instruments. The electric chronometer gave the countdown of the seconds.

The quiet that followed was interrupted by the confident firm voice of Nikolai Batukhtin: "Missile on course!"



This is what was left of the aerial pirate who dared violate the Soviet border.

On the indicator screen two small points quickly approached each other. It was the missile hurtling toward the plane. It could be clearly seen how a tiny cloud flared up, and a number of flashes occurred. That was when the destructive metal hit the foreign plane and clipped off its tail and wings.

"Target destroyed!" briefly, in military fashion, the officer in charge of guidance reported to Voronov.

Major Voronov informed the command of the fulfillment of the task. Then he looked at his watch and quickly wrote in the diary: "Plane shot down by the first missile at 1053 hours Sverdlovsk time."

Soldiers, sergeants, and officers emerged from the cabins and concrete shelters onto the emplacement, among them the soldiers of the firing detachment commanded by Sergeant Aleksander Fedorov.

Someone shouted: "Our missile hit its target! The aerial pirate was shot down!"

The soldiers, who had honorably fulfilled their task for their homeland, gave vent to their joy.

An unusual, joyous exhilarated feeling also took hold of Major Voronov. The same had happened to him during the Second World War when he watched Junkers and Messerschmitts falling and burning after they had been hit by Soviet AA fire.

But this did not last long. Fulfillment of duties could not be deferred. Returning to his cabin, Voronov wrote his official report:

"To the commander of the military unit:

REPORT

"I report that your order to destroy the plane which crossed the borders of our homeland and trespassed the state boundaries of the USSR on 1 May 1960, was carried out at 0853 hours Moscow time.

"When the plane entered the firing zone at a height of more than 20,000 meters, one rocket was launched and its explosion destroyed the target. The destruction of the target was observed on the instruments, and after a short time visual observer posts saw fragments of the plane falling and the pilot of the destroyed aircraft parachuting down. I reported the results of the fight to the command and took measures to detain the pilot descending by parachute.

Major Voronov
1 May 1960."

Some time passed, and in front of the Soviet officers sat the pilot-spy Powers who, on the orders of his masters, encroached upon the borders of the Soviet homeland.

He was being questioned:

"What was the purpose of your flight?"

"I was fulfilling orders."

"In the name of what?"

To this question Powers could not give a reasonable reply. But with fear in his eyes he told in detail how he had been hit by the Soviet missile.

"Unexpectedly I heard a dull explosion and saw an orange glow. The plane suddenly turned over and it seemed to me that the wings and tail fins had broken off. Perhaps the plane had not been hit directly and the explosion had occurred somewhere near the plane causing the pressure wave or fragments to hit the plane... I was shot down approximately 25-30 miles south or southeast of the town of Sverdlovsk. At that moment I was flying fairly accurately on course...

"When the plane fell, I was pressed to the dashboard and therefore could not eject myself; instead, I raised the cockpit canopy, unfastened the seat belt, and crawled from the plane over the top. The parachute opened automatically."

Not far from the firing position of the squadron, fragments of metal were found where the American spy plane had fallen. This indicates the accuracy of the Soviet military rocket, used for the first time after the war by rocket troops in the defense of the Soviet sky.

That same day the entire world spoke about the achievement of the soldiers, sergeants, and officers near Sverdlovsk. The Soviet rocketeers gained fame all over the world.

Their countrymen highly appreciated their exploit, and orders and medals were conferred on a large group of soldiers of the air defenses.

Again, one must recall the traditions. The motto of the AA gunners, "To shoot down the enemy with the first salvo," now changed into the motto of the rocketeers: "To destroy the target with the first rocket."

This clearly indicates that rocketeers not only have their live traditions, but also develop the glorious traditions of their older comrades who fought at the fronts and selflessly beat the enemy at the time of the Second World War.

Much time has passed since that memorable day when a powerful blow by a rocket brought the aerial pirate down to the ground, but the glorious fighting traditions are handed down like a relay.

In the unit almost all the men have been replaced, soldiers and commanders alike. Of those decorated with orders and medals for the successful fulfillment of the given combat task no one is left. Sergeant First Class Fedorov and Sergeant Shuster have already been working for a long time as civilians. The officers Voronov, Chernushevich, and Kolosov, having been promoted, now serve in other units. First Lieutenant Fel'dblyum was also promoted, and left the unit. His former colleagues congratulated him on the military rank he had received.

Time passes quickly and irrevocably, but the memory of the exploit of the rocketeers and their glory still live in the unit, and the ties with the heroes are not broken. Lieutenant Colonel Voronov came for a visit. He told the soldiers of his memories of the fight in which the power of the Soviet rockets and the excellent training of the soldiers and officers handling them were demonstrated to the whole world. In their turn the soldiers told the veteran about their achievements. They had much to tell. The number of outstanding workers, highly qualified specialists, and excellent units is growing. The norms of combat training are being surpassed, and people are continuously learning work adjacent to their own specializations.

Beam of the launcher with which the American spy plane was shot down on 1 May 1960.*

Many soldiers are familiar with the names of their regimental comrades who in an exemplary fashion fulfilled the combat task of destroying the spy plane. They all have in front of them the launcher decorated with a red star — the traditional symbol of a success scored in combat. The crew of the launcher is now commanded by Sergeant Prokopchuk, an excellent and skillful soldier.

In the Lenin Corner the portraits of the participants in the famous fight are on view together with the photographs of their successors in fame. This honor was conferred on Master Sergeant Zinchenko, Sergeant Spodar, Private First Class Martyushev, and many others.

"An old glory loves a new one," says Captain Bokov, the commander of the excellent unit. "The rocketeers understand that very well, and put every effort into learning."

* [Text in photograph: "From this launcher the spy plane U-2 was shot down on 1 May 1960."]

FIGHTERS OF THE FORWARD LINE OF DEFENSE

The complicated rocketry required of the soldiers serving in the army, profound technical knowledge, persistent and unremitting studies, and the bold and resolute overcoming of difficulties — could these challenges be met? "Yes" said the rocketeers. They were greatly devoted to their formidable weapon, but this devotion had grown gradually. The new weapon was unusual and complicated, causing some soldiers to lose confidence in their strength: they hesitated and repeatedly assessed their ability, instead of boldly marshaling their strength and attacking the problem of learning.

The threefold Hero of the Soviet Union A. I. Pokryshkin recalled such an incident. It was suggested to First Lieutenant of Technical Services Kuz'min that in the interest of the service he should be transferred to a rocket unit. Until then he had been an aviation technician. He knew his work very well. He loved aviation to the exclusion of everything else. The suggestion, therefore, came unexpectedly for Kuz'min, and he even protested.

Since then a long time has passed. Officer Kuz'min became a qualified and dedicated rocketeer. The following conversation took place between Kuz'min and the commander who had suggested his transfer:

"Well, Comrade Kuz'min, do you reproach me for suggesting your transfer to the rocket unit?" the colonel asked.

"Not at all; I am very grateful to you. Only now do I realize what my vocation really is."

This is not the only instance. Many artillerymen, airmen, sailors, and infantrymen looked at the beauties — the rockets — with some distrust at first, and persistently elicited detailed information from people in the industry, in order to find out "what is what." However, that was only in the beginning. Afterward everything fell into place.

The soldiers became familiar with all the apparatus and instruments, learned to work independently with the complicated equipment, and finally gained complete control over the entire rocketry which before had seemed so inaccessible.

By now most of the officers, sergeants, and soldiers of rocket units are qualified to compute with speed and accuracy the required data for guiding the rocket to the target and to prepare a rocket carefully for launching. This has been achieved by daily study and practice in classrooms and under more complicated conditions in the field, and by strenuous learning and days crammed to the limit with fruitful work.

Here is a typical episode from the life of the rocketeers:

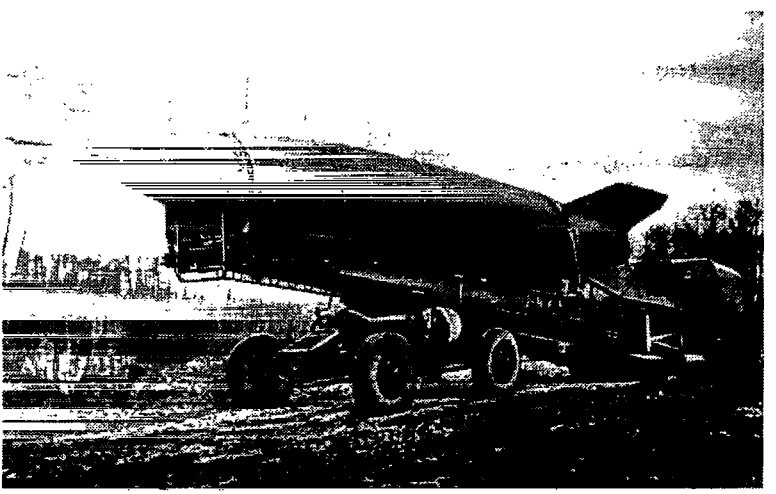
After presenting details of the training task, the commander gave the order to advance.

The lead truck moved slowly. The entire convoy of trucks moved behind it, keeping the required distance. There was so much dust that the road was literally hidden by an impenetrable cloud. Carrying very little traffic, the road was intersected by hidden slopes and rising ground, ravines and wooded strips. The dust permeated the cabs, covering the soldiers' faces thickly, grating between their teeth, and forming a thick layer on the weapons.

Under such conditions it is even difficult to drive in daytime, and at night moreover the lights must be dimmed. It was difficult for everyone, but probably most difficult for Mikhalev, the driver of the tow car. The transport of the ballistic missile was entrusted to him. The powerful dread weapon was carefully wrapped in many covers. Together with the tractor the length of the "train" was about twenty meters, and it had to be driven smoothly over the sharp gullies and protrusions.

Through the veil of dust one could hardly see the outline of the road. Only in the narrow beam of the headlights could the red circles of the reflectors be seen. Mikhalev worked the handles and pedals masterfully. His skillful action was keenly followed by the officer Kharchenko who sat next to him. He was prepared to assist the driver whenever it might become necessary.

They passed a slope. Shifting into lower gear, Mikhalev looked at the road attentively. Hemmed in on both sides by almost vertical walls, it turned sharply to the left. This alerted the officer. He motioned the driver to stop. He jumped to the ground. Advancing several meters on foot, Kharchenko signaled with a torch to move forward.



Missile in transport.

After having negotiated a difficult stretch, the convoy emerged into the plain. It now attained a speed of several tens of kilometers per hour: it was necessary to make up for lost time and to arrive at the appointed place on time.

They arrived at the launching site. There were no engineering installations. The missile and everything required for its launching were on wheels. That meant that the rocketeers could quickly prepare a missile for launching here or move to another position.

"Prepare missile!" Officer Smirnov commanded loudly.

The soldiers of the unit rushed to their places. They worked quickly and skillfully. Every movement they made demonstrated their training and skill. Only a few seconds passed and the missile was uncovered and ready to be lifted.

The engine sang with a high tone. Under the tension the cables and girder joints crackled, the metal literally sighing under the weight of the missile. The missile, sparkling in the sun, began slowly and smoothly to rise until it was vertical, standing majestically and proudly.

"Right-hand rod in order!"

"Left-hand rod in order!" were reported.

In another moment the strategic ballistic missile was in its place.

The commander, clicking the stop watch, said loudly so that everyone could hear him, and with undisguised pride in his subordinates:

"The time was a whole minute better than required by the norm. The work of every man is rated as 'excellent.'"

The training, which includes a journey, is not so successful every time. Sometimes it is considerably poorer. Forest paths are especially dangerous. They are winding and narrow, and are generally bordered by strong trees which grow, as if on purpose, in the wrong places. It is even difficult to drive a nimble small "Gazik" here. It is much more difficult to drive a broad "KRAZ" truck to which a trailer many meters long is attached on which the missile lies. It cannot be folded up or bent to suit the road. The missile must be delivered whole and in order, and, moreover, at the specified time, no matter how this is accomplished.

At last dawn was breaking. A little further and the truck would reach the appointed place. The tired driver sighed with relief and for a moment did not pay much attention. What he had feared during the entire journey occurred just at that moment. The machine shuddered under a blow, and the unpleasant scraping of metal against wood could be heard. Suffused with cold sweat, the driver stepped on the brake as hard as he could and almost at once the heavy "KRAZ" stopped. But it was too late.

The general in charge of the training, and the colonel who commanded the unit approached the truck. They were accompanied by a group of engineers and officer umpires.

The driver stood there pale and shaking. The commander of the launcher, who sat next to the driver, also viewed the crushed fin of the missile guiltily. The expensive missile was put out of commission.

"It will have to be returned to the base," the commander of the unit said.

"Yes, there is nothing we can do," the general agreed.

"What if we carefully straighten out the fin?" First Engineer Lieutenant Grigorenko suddenly joining the coversation. The general looked attentively at the young smart-looking officer. Condescendingly he smiled:

"Sorry, no good. You know the technical requirements. Not a single flaw is permitted on the missile."

Grigorenko blushed, but he did not relent:

"In that case we can cut off the damaged casing of the fin and weld on a new one in its place."

"Well, that is an idea, to weld on a new casing," said the general as his eyes lit up. "Aren't such mishaps possible under combat conditions? Will we also return missiles to the base from the front when something happens? No, we must try it out. I agree to make the experiment."

"Well, if the general agrees, I have no objection," the commander of the unit declared.

The mood of the soldiers improved immediately. A minute or two passed, and work began on the spot, there in the woods.

It took some time, but at last the repaired missile differed from the other missiles only by the fresh paint on the fin. However, only this missile was taken to the range and prepared for launching.

"Launch!" the general ordered.

The missile hit the target exactly.

The commander of the unit commended the skilled hands of the repair men, Privates Churochkin and Markov, and also had encouraging words for all the serving men who had not yet taken part in practical work under field conditions.

How can the bold action of the rocketeers, who took upon themselves the great responsibility of repairing the missile under field conditions, be explained? How can their initiative and inventiveness be appreciated?

There can be only one answer. The Soviet soldiers, with these positive qualities and other glorious traditions, follow in the footsteps of their older brethern of the same branch, the artillerymen of the Guards mine-thrower units, who during the Second World War performed many heroic deeds in repairing, reconditioning, and otherwise modernizing the weapons entrusted to them.

Here is just one example. In autumn 1942 heavy fighting broke out, first in the foothills, and later in the high passes of the Caucasus. The cunning enemy assigned to this sector of the front units especially trained for fighting in mountainous terrain.

The Soviet infantry units, which quickly adapted to the tactics of fighting in the mountains, were badly in need of artillery support. Thus, the Guards mine-thrower units were confronted with the problem of how to help the "mother" infantry.

Many specialists, even some prominent ones, predicted that the Guards mine throwers would remain inactive under such conditions. Really, it seemed impossible that the "Katyushas," weighing many tons, could be drawn up the mountains and into the ravines.

However, a solution was found through the inventiveness of the soldiers, and their high sense of responsibility for the defense of their homeland. A light-weight variant of the missile launcher, consisting of several components which could easily be carried separately by hand, was constructed under field conditions by the Guardsmen of the mine-thrower units, together with maintenance men while under enemy fire. They used guide-rails of the ordinary combat vehicles and M-8 missiles. The new design did not have the firing power of the BM-8 launcher because there were fewer guide-rails, but on the other hand each missile had a greater effect

on the enemy than a whole battery of conventional mortars. The problem of using Guards mine throwers in mountain regions was solved under frontline conditions, so boldly and simply.

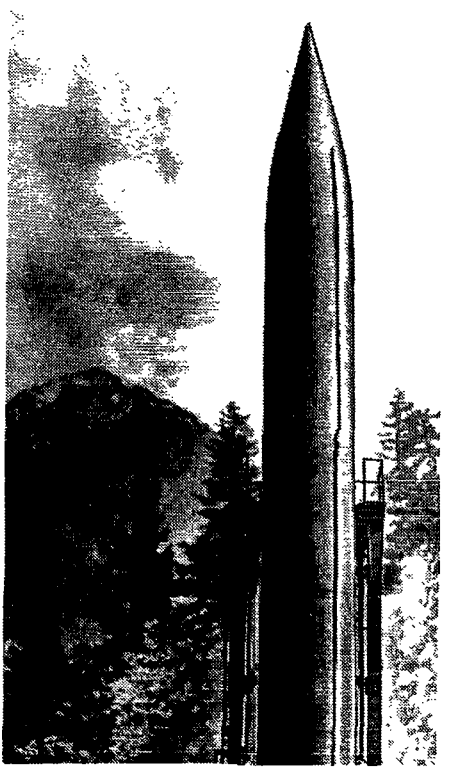
That was a fine example for Soviet rocketeers.

The culmination of the rocketeers' training is combat firing. The soldiers prepare for this painstakingly, with perseverance and solemn awareness of their responsibility. They practice their individual duties heeding every detail. The readiness of the operators and the training of the commanders of the combat vehicles are checked repeatedly.

The tensest moment is finally the firing itself.

This is how the newspaper "Krasnaya Zvezda" described the most significant moment in the rocketeer's work — the combat launching of the missile:

In the afternoon the weather got worse. The sky was covered with ashen gray clouds, and snow began to fall. The wind drove it furiously into the soldiers' faces, and it covered the vehicles and equipment as a white sheet. It was dusky and chilly in the woods. However, this was incidental, and remained unnoticed by the rocketeers who were engrossed in their combat activity. Nothing could deter them now. One could clearly feel the tense rhythm of the work preceding the launching.



At the launching site.

The trailer with the missile had been driven to the site at which the launching device was located. Surprisingly this vehicle also served as gun carriage. A missile launcher, like an artillery gun, also has a carriage. However, its purpose here was quite different. Here it was a veritable miracle machine.

When it was advanced to the launcher and someone pressed a knob on the control desk, the upper cradle with the missile lying on it shuddered as if it suddenly felt the weight, and then one end began slowly to rise into the air. The missile reached a vertical position and was supported at its tail end by the launching device.

The missile launcher was under the command of officer Petrov. He was admirably "sensitive" to its slightest movement. Concentration was reflected in his calm face. Everything indicated that the maneuver was progressing as it should. The missile was in the required position. With some more effort on the part of the soldiers, it stood sturdily in its place, pointing toward the sky.

The soldiers had not neglected a single detail of camouflaging. There was nothing superfluous around; everything was under cover.

The crews ran toward the missile. Where the missile would fly and whether it would hit the target depended on them. The range of flight can be regulated. The controls of the missile must be adjusted accordingly.

Some soldiers, exposed to the icy wind, worked at a dizzy height, but that did not deter them. They skillfully fulfilled their duties, demonstrating their excellent training and good physical shape.

The last preparations for the launching were being made. The launching site became quickly deserted. Every soldier reported to the commander as he finished his task and then went to take shelter. Only a few people were left next to the missile. An iron rule applied here: every soldier had to be at his post.

The carriage was removed.

"Missile ready for launching!" officer Petrov reported to the battery commander.

"Everyone to the shelter!"

The site was completely deserted.

Only officer Belous remained. He rechecked the reliability of the cable connection which supplied current to the equipment of the missile. This was the last thread connecting the missile to the launching pad.

Having satisfied himself that everything was in order, the officer went to the remote control panel of the launching. On the desk there were many knobs, and red and white signal lamps. Only the white lamps were on. That meant that everything was in order. If anything was out of order, a red lamp would light up immediately. This not only indicated that something was wrong; it also showed where the difficulty was located.

The command point was quiet so far. The seconds dragged on. Someone's voice could be heard on the main telephone line.

Then came the command: "Fire!"

The operator pressed a button and ... nothing happened. It was expected that the missile would emit a roar and begin to rise, but everything was quiet. As before the missile stood immobile in its place.

However, that lasted only a few seconds. Then a mighty roar was heard, very similar to raging thunder. Everything was lit up by a purple flame.

Around the launcher a huge column of smoke and snow rose. The rocket shuddered, for several moments it was literally suspended in mid-air, and then it quickly gathered speed and rose into the air.

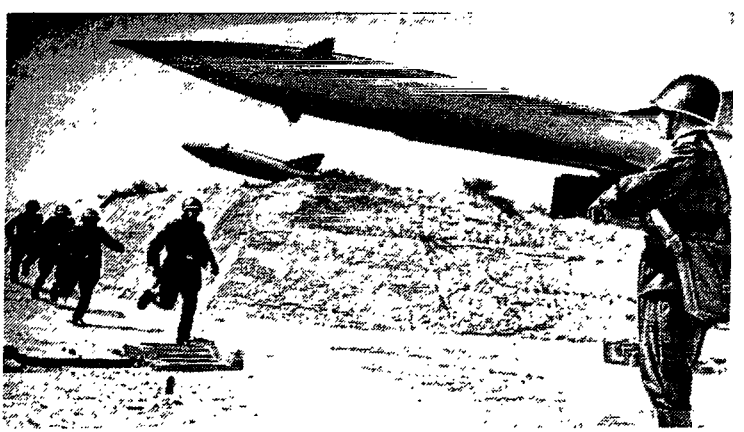
Another few seconds passed. Officer Belous, looking after the receding missile, remarked, not without pride: "It's off!"

The launching of the missile is for the rocketeers themselves a solemn moment. They wait for it, as for an examination, with "butterflies" in their stomachs. How else could it be? After all, the flight of the missile is the final result of all the strenuous combat training. If the missile takes off and hits the target exactly, it means that everybody did his part and excelled in carrying out his task.

It has never happened in this unit that a missile did not take off at all. Every time the rocketeers went through their training and carried out a combat launching, they were rated as "excellent" or "very good." Here people mastered technology completely. Such units are trained every year in increasing numbers.

In the Strategic Rocket Forces alone the number of subunits which were outstanding increased threefold in 1963, more excellent units were trained, and the number of specialists in certain categories increased greatly. Almost all the practical combat launchings of medium-range missiles were rated as "very good" or "excellent," and the combat units of intercontinental missiles performed their tasks for several years running with unwavering excellence.

The successes of the rocketeers were duly appreciated by the homeland. By order of the Minister of Defense of the USSR, officers Gurov, Popov, Zenin, and Kuznikov got accelerated promotion on account of the high level of readiness of the men and the excellent cooperation of the units. Many commanders, engineers, and technicians were decorated with orders and medals for learning to work with the new rocket technology. Among them were officers Moskal'tsev, Oleksintsev, and many others.



Antiaircraft rocketeers taking up positions after alert.

The air-defense rocket forces also undergo strenuous military training. Their armament incorporates the best that has been produced over the years. The soldiers of the antiaircraft defense continuously improve their combat efficiency, achieving new successes in combat and political preparation.

The ordinary working days filled with training give a clear picture of the military work of the rocketeers, and explain their success.

Alert! A certain number of seconds is required by each rocketeer to take up his assigned working place. As always, among the first to arrive at the command point was First Lieutenant of Technical Services Zakharenko. Quickly checking to see if the instruments were ready to be switched on, the officer also managed to check the work of his subordinates. Brief reports about the readiness for switching on were issued, and the site was filled with the noise of motors, ventilators, and the clicking of switches. The hand of the chronometer moved inexorably over the dial. The operators endeavored to save time, and to improve on the given norms.

First Lieutenant Zakharenko checked the complicated equipment with quick and skillful movements. One operation, the next... On the screen of the control oscillograph the electron beam drew a complicated graph. To the uninformed it might have seemed that the image on the screen was a result of chaotic movement of the beam. But the officer quickly scanned the screen and saw what the check had to reveal: the instruments worked perfectly.

"Everything in order!"

Side by side with First Lieutenant Zakharenko worked his subordinates Sergeant Charykov and Corporal Borodin. They were experienced specialists. They worked accurately and skillfully with the instruments entrusted to them.

The targets appeared on the situation screen. Now the time was already being counted in fractions of a second.

The commander gave the order to destroy the target. The operators had their eyes glued to the indicator screens.

On the edge of the screen a speck of light appeared, indicating the target. A moment passed and the target was "seized" by the guiding operator. One report followed another. The moment the target entered the firing zone, a brief report was heard: "Fire!" The missile "took off" toward the approaching target.

At that time new data kept coming in. The rocketeers were ready for any test.

After the "combat" was over, the commander congratulated the specialists operating the locators on their excellent work.

Among the launching personnel and the locator operators there was a sense of belonging together — a patriotic feeling. The rocketeers understood with their hearts and souls the enormous responsibility which was placed on their shoulders. It was not surprising that their great feeling of obligation roused in them special standards of work and behavior.

Another unit settled down not far from the locator operators at the rockets.

It was commanded by the secretary of the Party organization Lieutenant Klykov. The training consisted of combat work on training missiles, and later on combat missiles.

The lieutenant said:

"I may say that little remains to be done for the missiles to be fully ready for combat. In short, we will not let anyone catch us. At this moment, Corporal Litvinchuk's unit is in the shelter. Let us see what the soldiers have learned." Turning to his deputy, the officer ordered:

"Switch on the alarm!"

The rich, deep sounds of a siren started up, and suddenly a combat group emerged from its hiding in a nearby wood. Short, precise commands and reports were heard:

"To your places!"

"Number one ready!"

"Combat position!"

Some hurried, almost imperceptible motions by the soldiers followed: the cover was removed, something was done next to the launcher, and already the nose of the training missile was being bared and it began to rise.

The officer looked at his watch, and as soon as the missile was in the correct position, he ordered the crew: "Take cover!"

Looking at his watch and checking to see if all the devices were correctly set up, the commander announced:

"The norm was improved by two minutes."

He checked again.

"Yet, that's correct. The crew worked superbly."

But let us return to the locator operators. The time was approaching 1500 hours. They were just completing the routine inspection. There was the sound of the loudspeaker system being switched on. From the loudspeakers came the order:

"Report the instruments ready to be switched on!"

The reports followed one after the other. The central control knob on the desk was being pressed and now the ventilators whirred with their steady, penetrating sound; signal lamps lit up indicating that the instruments were switched on. The loudspeaker gave the time with the accuracy of a metronome:

"One minute, two..."

Finally the last minute arrived. All the reports had already been received. After the routine inspection, the instruments worked perfectly and were ready to guide the missile to its target.

"Switch the instruments off!" rang out the command.

Several automatic movements and the ventilators gradually became quiet and the switches clicked. The soldiers received a well-deserved rest.

Many of the outstanding soldiers and officers serve in the rocket forces of the antiaircraft defenses. Some of them earned this glory when they were still antiaircraft artillerymen; others earned it through their hard work in learning to handle rocketry. The third group merited this distinction at the time of the war, and have added to their glory by new and outstanding exploits.

The name of the member of the Young Guard, Zhora Arutyunyants can often be heard among the rocketeers. He donned the army uniform immediately after the liberation of Krasnodon. At first they did not want to accept him in the regiment.

"You need a rest badly," the colonel told him, looking at his exhausted face.

But could Zhora rest while somehwere near Krasnodon the field commander who had tortured Oleg Koshevoi was at large, while the SS-men who had tormented Vanya Zemnukhov walked about, while the henchman who pushed a ramrod into Seryozhka Tyulenin's wound was still alive.

Zhora Arutyunyants became a soldier in the company equipped with submachine guns. Autumn 1943 was a difficult time. The roads were washed up, the rivers and creeks flooded the country, and the foxholes and trenches were under water. The autumn mud fettered the legs, and sucked in guns and vehicles. But nothing could stop the Soviet fighters. Arutyunyants with his submachine gun continued westward with his new friends, toward victory against the enemy. In every fascist at whom he took aim he saw these savage SS-men who threw his tortured Young Guard comrades into the mine shaft.

At that time Arutyunyants did not yet know that the commander of the Young Guard, First Lieutenant Turkenich, was fighting in the same division. They met some time later at divisional headquarters where they had been summoned to hear about the rewards the government had bestowed on the members of the Young Guard. The two friends, the soldier and the officer, fell into each other's arms and reminisced for a long time about their comrades in the past fighting. That was their last meeting. Soon afterward Zhora Arutyunyants was badly wounded and was taken to hospital. Later he learned that Ivan Turkenich had met a hero's death in Poland.

The war came to an end. The hero from Krasnodon had no problem deciding what to do. He had already decided some time before to become a professional soldier. He graduated from artillery school, then from the Academy, and afterward served in the Guards unit which traced its beginning back to the antiaircraft battery, formed at the Putilov plant in the pre-October days of 1917.

The unit in which Lieutenant Colonel of the Guards Georgii Arutyunyants serves is one of the best. More than once it received the challenge banner of the town which was under the protection of the Guards rocketeers. To win this honorable banner, the hero from Krasnodon contributed with all his strength. His work was duly rewarded by the government.

All the rocketeers study strenuously in order to master the latest rocket techniques. In any rocket unit one will find carefully equipped classrooms, various diagrams, and working models. The soldiers come here not only during hours scheduled for learning — they drop in whenever they have a problem, or when something is not clear to them, or if they want to spend their free time acquiring additional knowledge.

In the classrooms and directly on the launching sites, heated arguments erupt over the best means of utilizing the weapons and of saving precious minutes and seconds in the preparation of the weapon for combat. The soldiers learn much that is new to them; they become excellent fighters and highly qualified specialists.

The rocketeers need considerable knowledge in order to perform their combat duties well, for the vigilant defense of the country's airspace. In antiaircraft rocket units the following order from the commander can often be heard:

"Fall in for combat duty to defend the aerial borders of the homeland."

In response to such an order, the unit moves to the combat installations. A certain time elapses and then follows the report:

"Personnel and combat installations ready for combat duty in defense of the sacred borders of our homeland!"

Bazooka men.

Then a strenuous life under combat conditions begins. At the command point there is the usual activity. Corporal Tsarev listens attentively to the dots and dashes. Private Belous has prepared everything necessary for working out the path of the target.

Suddenly Tsarev receives an alert: a plane has been sighted in the air. A string of numbers received by the communications man traces a straight line on Belous' plane table. The commander is busy: if the target remains on course, it is bound to enter our zone...

"Alert Number one!" he orders the unit, and reports it to the higher commander.

Altogether very little time has elapsed, and the unit commanded by Master Sergeant Eshchenko is already in its place at the missile launcher. Soon one can hear:

"Crew member one ready!"

"Crew member two ready!"

Thus all the numbers of the unit report.

"Prepare the missile for launching!" the master sergeant orders, having received the instruction from the battery commander.

The rocketeers work silently. Only monosyllabic orders and short reports are heard. The instruments click. The gears start turning. The huge body of the missile is reared up and obediently turns into a vertical position.

With bated breath the soldiers wait motionlessly for the next order. They all know that the next order may be "Fire!" Then suddenly the missile tears away from the launching pad.

The path of the target is plotted on the table. The commander does not dare cancel the alert — the target may reappear. He decides to use every means to ensure accurate observation of the target.

All the rocketeers work equally hard. During their work and military training they become acquainted with the fundamentals of modern science: physics and mathematics, electronics and cybernetics. Afterward the knowledge acquired is tested in practical training such as has been described in detail. The antiaircraft rocketeers, just as the soldiers of the Strategic Rocket Forces, also like the practical firing exercises best. These provide the opportunity of testing what the soldier or officer has actually learned. The launching practice of the missiles is always a well-organized event, and leaves a deep impression on every soldier.

At the launching site the commander of the launcher assembled his men for the last time and reminded them:

"Everything depends on three things: personal training, cooperation, and discipline."

As if in response to that, the norm for charging the launching device was excellently fulfilled by the crew. The men worked with precision, concentration, and speed, and there was not one superfluous word nor one futile movement.

The loaded launcher came to a halt at the edge of a wood. The rocketeers removed the covers from it, camouflaged it carefully with branches, and resumed their combat positions. Wearisome minutes passed while they waited for the drive to the launching site. It is hard to guess the thoughts of each soldier, for there are as many emotional experiences as there are hearts. However, it can be said with assurance that the comradely combat team generally lived with only one thought, one worry: to fulfill the approaching task with "excellence."

They finally reached the launching site, a flat field covered with low brushwood. At some distance was a trench which had been dug previously where the members of the unit took shelter at the moment of launching; it was exactly the same as the trenches which had been dug at the front by the soldiers who operated the famous "Katyushas."

The command was given:

"Prepare for combat!"

At the launching site the soldiers worked quickly and with discipline. While some of them prepared the device for launching, others ran the cable into the dugout... The norm was again fulfilled in the most satisfactory manner.

"Lift the missile!"

The missile, which had been in a horizontal position for transport, slowly began to rise above the launcher, above the dense underbrush, and to point into the cloudless blue sky.

"Missile ready for launching!" the crew commander reported to the battery commander.

The crew took shelter. For some moments an uneasy silence hung over the launching site in expectation of something extraordinary. Then a short powerful roar, similar to the sound of a firing jet engine, resounded all around. In clouds of dust, smoke, and flames the missile slowly tore itself away from the launching rack; then it appeared to "sit" down under the impact of the force of gravity; finally, it gathered speed and shot upward at an ever increasing rate.

Then came the most exciting minutes — the waiting for the results of the launching. Where did the missile fly? Did it hit the target? How would the highest command assess the firing?

The launcher was already in a dense forest under cover when the good news arrived: the crew had fulfilled its task excellently, the launching was successful, and the target was hit accurately.

The rocketeers were happy, and congratulated one another. Their difficult work had not been in vain.

An antiaircraft missile streaks into the sky.

However, things do not always go smoothly in the rocketeers' life. There are mishaps — there are even failures. When things are particularly bad, the rocketeers draw upon the experience of their fathers and older brothers.

A noteworthy incident is said to have occurred in some unit. Among the young replacements in the unit was Private Chmelik whose negligence showed immediately. He was tardy; his reply during training was out of place. For a long time the commander of the launching crew and other officers tolerated his behavior, but this had no effect on the soldier.

Once the commander gave Chmelik an assignment, but it seemed tedious to the soldier, so he did not finish it, and he left. He was punished for this breach of discipline, and his misconduct was announced at meetings. This was also ineffective.

One evening when Chmelik sat in the Lenin Corner, Sergeant Kazanov, a professional soldier who served throughout the war in that unit, went over to him.

"Is it true that you just up and skipped?" he asked.

"Exactly, Comrade Sergeant," the soldier replied.

"In our unit there was a Private Kirichenko. He did not run away although the fascists opened fire on him. Did you hear about Kirichenko? He was just like you. Only different in character. He was hard as flint!"

The sergeant told the soldier about the exploit of the hero. It was during the war. The radiolocator station, commanded by Lieutenant Matyushev,

was situated near the frontline, and informed the antiaircraft batteries protecting a large industrial center of the approach of fascist bombers. The Hitlerites eventually ferreted out our station and decided to destroy it.

Many shells fell all around in quick succession, but the locator men did not abandon their places. The operator Yaryza met a hero's death there. Then a fragment hit the Red Army man Kurganov.

Again operator Kirichenko showed his character to be like flint. No matter how hard the fascists hit the station, he did not leave his place at the screen. When the fascists again sent up their bombers, he crawled to the telephone and reported with a barely audible voice the approach of the enemy in the air, although he was badly wounded after having been thrown down by a pressure wave.

This raid was also repulsed.

"Such was our Kirichenko! Not even by fire could the enemy remove him from the place assigned to him by the commander. And you left on your own account."

For the first time, it seemed, Private Chmelik relented. Later he admitted to his friends that after the sergeant's narrative he was more ashamed than he had ever been in his life. This conversation obviously brought about a complete reversal in the soldier's attitude. Later, too, the sergeant spoke with him several times about the traditions of the frontline fighters. At last the soldier became reasonable.

True to their combat traditions, the soldiers of the present antiaircraft defense stand guard assiduously.

Just as variegated and interesting is the life of the rocketeers in the navy and in the air force. To confirm this, we shall spend some time with Lieutenant Commander Dubrovskii in one of the modern combat vessels.

The predawn quiet was shattered by the noise of the engines. The vessels receded from the shore and, gathering speed, they crossed the wide expanse of the bay, heading for the open sea.

"If someone asked me," said Dubrovskii, "what is most remarkable about these vessels, I would point out the stars which adorn their superstructure — the stars with the letter "R." "R" stands for rockets, and stars are a kind of diploma of military prowess. They indicate that the rocket-propelled missiles launched from these vessels will hit their target with unerring accuracy."

Twenty years ago war raged here in this blue expanse where these lively vessels now scuttle about. The present commanders, mechanics, and rocket operators follow in their fathers' footsteps. A modest monument on a pedestal was placed in a square among accacias and maples in memory of those days. Standing there, one can clearly visualize the hail of fire which was unleashed in those troubled times, and the heroism of the sailors as they sank enemy vessels and transport ships. It seems that from here, from the monument, the heroes signal day and night: "Follow our example!"

We descend to the shore, make a round of the ships which have just come in from the sea, talk to the people, and observe how they respond to this exhortation.

Here is a vessel which does not differ outwardly from the others, but it was the first to be able to affix a star to its superstructure. This is the best vessel of the unit.

We meet its crew. Its commander is Lieutenant Commander Kuz'min. During the war his father commanded a unit of torpedo boats in the Northern Fleet and trained many excellent torpedo men. Among those who have continued in their footsteps is his son.

The commander's comrades-in-arms are rocketeer First Lieutenant Korovaiko, the chief engineer Midshipman Sukhonov, the radiometer operator Petty Officer 2nd Class Dobritsa, and others, people equally seasoned. Everyone of them has to his credit many assignments fulfilled with excellently.

Recently the vessel sailed to attack a convoy. It was a dark rough night. The search was difficult — they had to tolerate radio interference. The ship rolled. Even an experienced sailor had difficulties staying on deck in such weather, and some of the younger ones had only been to sea two or three times.

The fight with the gale and the ruses of the "enemy" lasted several hours. But, as always, the commander proved to be equal to his task, as did the radiometer operator and the protegés of Midshipman Sukhonov — the engineers — modest workers whose profession generally prevents their breathing the fresh sea air.

In every crew there are people whose skill serves as an example. Prominent among them are the communists. On small vessels there are not many of them, but they are able to weld any team together so that there is no room for laziness, indifference, or faintheartedness in the face of the difficulties of naval service.

At one time the initiative of Petty Officer 2nd Class Silkin led to the following remarkable patriotic challenge: to become proficient in adjacent professions and to attain the level of skilled specialists. For his initiative he was rewarded by order of the Commander-in-Chief of the Navy. Among the first to support this useful attempt were the communists. They carefully organized the exchange of experiences, helped the command to improve the teaching and to provide the necessary technical apparatus, and criticized the lovers of "storm effects" who did not follow up words with deeds. All this, which at first sight seemed trivial and insignificant, yielded wonderful results. Many people acquired an additional skill. The commanders obtained excellent helpers who could not only replace a comrade at his combat station at any time, but who could also skillfully assist the sergeants in training young people and in raising the general technical level of the crew. Now the crews fulfill their assignments with "very good" and "excellent" ratings exclusively.

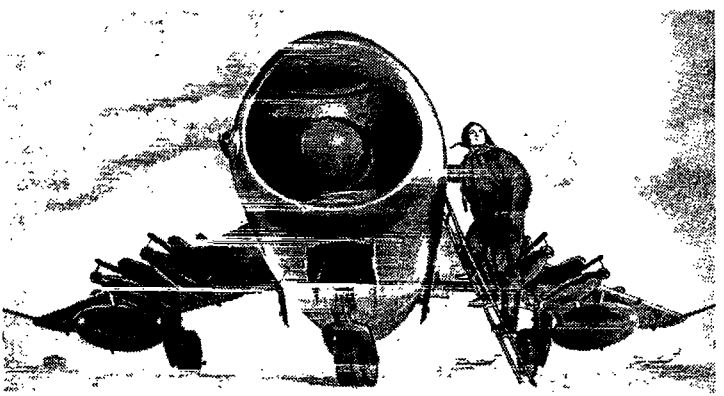
The power of military traditions is great. In any patriotic action the rocketeers feel that they are the heirs of the glorious deeds of the older generation of Soviet sailors. Although times and equipment were different then, and although other problems troubled people at that time, their hearts were aflame with passionate love for the homeland which inspired deeds worthy of eternal remembrance.

In one of the barracks where the soldiers of a rocket naval unit live there is a cot on which no one has slept for many years. A Pioneer badge lies on the snow-white pillow, placed there by solicitous schoolchildren. On the bedside table there is a sailor's cap. On the wall hangs a photograph of a tanned boy with bushy eyebrows and a good-natured, attractive face. Every evening at roll call the NCO in charge names the hero who died a

courageous death in the fight for the Soviet homeland and whose name was entered for ever into the annals of the unit. In an encounter with the fascists the torpedo boat on which the sailor served was attacked by enemy aircraft. Almost all the crew were killed. Then this petty officer, who had been gravely wounded, grabbed a machine gun and fought the enemy as long as his heart was beating.

Many young sailors have sat down at this cot for silent contemplation of their service; to many of them the hero's courage has been a help in work and in learning; many have been heartened and inspired!

Almost every day our vessels put to sea. New vessels — new people. Only one thing remains unchanged: unbounded love for the homeland — the desire to serve it selflessly, thus adding to the glory of the fathers.



Rocket carrier ready to take off.

The rocket aviators lead an equally strenuous and creative life. There are so many different types of people whom one meets in the air-force units! The commander of "fire and smoke" — that is the nickname of Captain Rusin of the technical service.

"Just look at our aerial artillery," he says proudly, letting his eyes rove over the cigar-shaped, dully gleaming missiles. "Look at the warhead," the officer points. "Its power is many times greater than that of a shell. Previously, to shoot down a plane it was necessary to hit it exactly. This is no longer so important. Now the missile destroys the plane even if it explodes at a certain distance from it. In general, a special guidance system installed in the missile automatically corrects errors in aiming, takes into account changes in the position of the aerial target, and ensures exceedingly high accuracy in firing."

Rusin leads us to a large hall where the missiles are being prepared for use in combat. Experienced rocket specialists, on whom the combat readiness of the unit depends to a large extent, work there. The soldiers are well aware of this, and they work with enthusiasm and a feeling of great responsibility for the work entrusted to them.

The fame of this unit commanded by Rusin has spread far and wide. For several successive years the unit has been rated as excellent.

In addition to rocketeers there are many other experienced specialists in the unit. There is the communist, officer Zakirdzhanov. His unit firmly holds first place among the technical units of the sector. Or let us consider First Lieutenant of Technical Services Samodelkin. The plane assigned to him has the largest accrued flying time. Its fuselage is adorned by 19 stars, representing nineteen victories in the air — nineteen "enemy" aircraft shot down by rockets.

Once during rocket practice we managed to be at the airfield where the rocket-carrying planes were based. A wonderful sight appeared before our eyes.

A brisk run, the takeoff, and the fighter plane set course for the shooting range. The outlines of a small town were lost in the haze. Above was the bluish-black sky. The plane approached the site of the aerial rocket firing.

After several minutes of flying on course, it was possible to see an airfield from which the target plane was to take off.

It was already on the runway. From above it looked like a toy, but it was a completely modern plane. It took off from the ground, gained height, and executed some turns. One had the definite impression that the plane was being flown by an experienced pilot. But this was not so. There was no pilot in the plane! It was controlled by radio from the ground by the commander of the firing, Major Chernousov. He was well acquainted with all the equipment at the firing range. Aided by the guidance navigator and the plotters, he knew where anyone was at any given moment, at what height and on what course the target plane was flying, and where the rocket-carrying fighters were.

The experienced pilot Major Kornienko bent over the screens of the locators. He ordered:

"'Ninety-one' course 210, and climb to ten thousand."

And as if an echo sounded:

"'Ninety-one' speaking. Roger."

"Ninety-one" was the code name of a supersonic rocket carrier. It was flown by the first-class Pilot Captain Alenichev. He was the first to shoot. This time the overall results of his extensive training on the ground and in the air would be revealed. So far all the training interceptions and attacks were carried out without the launching of rockets. This time the target was real, the missiles had warheads, and they were prepared for launching at any moment wherever the pilot would aim. Would they hit the target or would they miss?

The rocket carrier was guided into the target area. Events developed rapidly. On the screen of the airborne radiolocator Alenichev unerringly found the target.

"This is "ninety-one', I see the target!" reported Alenichev's voice.

And after a moment:

"This is 'ninety-one'; target intercepted!"

The complicated electronic instruments helped the pilot to follow the target, without losing it during the maneuvers.

The target was intercepted!

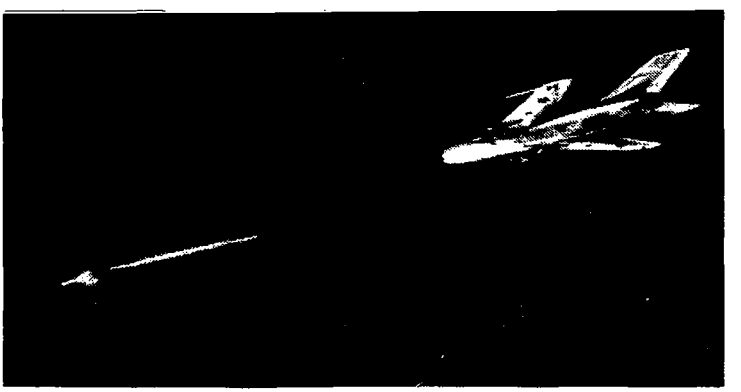
And then came the command: "Fire!"

Overtaking the fighter plane and leaving a fiery trail behind, the missile took off and disappeared from sight in the direction of the target with a truly blinding flash.

Ahead of the plane, where neither target nor missile could be seen any more, suddenly an orange flame lit up the blue sky, a thunderous sound drowned out the engine noise, and flaming pieces, overtaking each other, fell to the ground as if somebody had upset a giant vessel full of molten metal. These were burning fragments of the target, shot to pieces, falling to the ground.

Another explosion! Again thunder rent the blue sky. This was certainly an awe-inspiring spectacle: two missiles — and two targets disappeared without a trace! This was completely unlike what could be observed when fighter aircraft fired cannons or even rockets. Then the attacked adversary could still evade the blow, escape from the pursuer, flee to the airfield with a bullet-riddled fuselage, and land safely. Today this is out of the question. In an attack the missiles unerringly hit any aerial target, even if it is protected by the strongest armor.

No matter which unit we choose, the keynote is always hard creative work and systematic combat training. The appearance of basically new techniques and the supply of powerful missiles to the army caused a veritable revolution in the minds of people, and inspired them to master quickly and completely the powerful weapon, to learn to use it to a maximum within a short time, and to increase the defense potential of the country.



The missile flying toward its target.

The story of the rocket forces would be incomplete if no mention were made of the heroic profession of the rocket inspectors. Kostenko, the communist and engineer, has distinguished himself among them, and is usually described as the man with the fine nose of an inspector and a happy zest for life. Unlike an ordinary rocketeer who can quietly study the peculiarities and minute details of a rocket, the inspector has to acquaint himself with any new machine within a short period of time before it is tested.

The details, peculiarities, and character must be determined during the course of the tests. The final verdict has to be pronounced concerning the rockets: yes or no, whether it will live or whether it will swell the ranks of the models kept in a designer's laboratory. If it is fated to "live," all its good and bad qualities must be analyzed thoroughly, for this precise knowledge is indispensable to the future operation of the rocket. What the inspector overlooks will have later repercussions.

During the tests a rocket reveals its character in various ways: one may show it right at the beginning, another in the middle, and a third "according to the law of averages," as the inspectors say jokingly, as late as on the launching pad. It is often difficult to discover and understand the cause of peculiar behavior of such a complicated mechanism, equipped with the most varied and mutually interdependent instruments. It is therefore vital for an inspector to have a fine nose. With him, as with a physician, the art of making a correct and accurate diagnosis is the touchstone of his skill and experience.

The inspector must not only see what is happening now, but must also anticipate what might occur at some later time. Kostenko was born with this prognostic quality. Thus, although some of the latest developments in the field of computers are still only being discussed, the engineer has already begun to study them. Or let us take initiative. It is hard to visualize an inspector who would only work within the limits of the orders given him without showing any initiative himself. He would become a simple subordinate carrying out orders. But sometimes there are complaints against Kostenko: he deprives others from exhibiting their initiative by "beating them to the punch."

In the inspectors' work it sometimes happens that it is impossible to proceed unless the causes of abnormal behavior of the rocket are discovered. This happened when the inspector received a visit from the correspondent of the newspaper "Krasnaya Zvezda."

The huge rocket was lying quietly on trolleys in the hangar. Men in white coveralls were busy around it. When it was time to check the guiding system, some unexpected oscillations of the control actuating system suddenly appeared.

"Oscillations, oscillations" Kostenko wondered. "What's causing them?" The engineers made various suggestions and proposed ways of determining the cause of the trouble. Someone was even ready to implement some of these proposals. There were various plans. "To search like that, at random" Kostenko thought meanwhile. "What we need is one single approach."

Kostenko approached the rocket in the hangar. The officers saw how he hurriedly connected the instruments. Then he straightened up, wiping his forehead:

"Everything is clear. There is some trouble in the circuit of the power source. We will check..."

After that work continued for about three days on the rocket: joints were taken apart, covers taken off, all circuits checked, one part after the other was "sounded"... And they found it. An accidental defect in assembly, as the engineer had expected.

No less honorable and respected is the work of the rocketeers whose job it is to prepare rockets and check that they are in good working order.

Who among the rocketeers does not remember that a short time ago even the most trivial fault in the rocket could be remedied only at specially equipped places, sometimes many kilometers away from the firing positions?

At the firing range.

At first this seemed the right thing to do. How would it be possible to dismantle the complicated mechanism in field conditions? But experience and the soldiers' inventiveness overcame these unsubstantiated arguments.

Habits acquired through daily work, and advantageous and necessary instruments and adjustments introduced by efficiency experts made it possible to remedy the severest trouble in rockets directly in the firing position, and at any time, in winter or summer, day or night.

A group of soldiers under the command of the Komsomol member Merinov works skillfully under any conditions, preparing rockets for launching. As a symbol of military skill each soldier has on his tunic three medals for military valor. In their capable hands any job is accomplished, no matter whether they check a missile, do routine work, or carry out preparations for launching.

These are the best experts on rocketry, setting an example for the others by acquiring theoretical knowledge of the modern weapon, and by studying all the "secrets" of its design and combat capabilities in detail. At the same time they are masters in the practical preparation of rockets to be launched, and they can quickly correct difficulties which arise and fulfill the stiffest norms. Their behavior at the firing positions, in the classrooms, and outside their unit serves as an example of disciplined action and accurate fulfillment of assignments.

Not many years have passed since the new great branch of the armed forces — the rocketeers — joined the ranks of the glorious family of the

Soviet soldiers. But even in this short time the rocketeers managed to prove themselves to be people with a fiery heart and stout character. The glorious pages of their latest history contain numerous outstanding deeds, patriotic exploits, and heroic achievements.

Admittedly, we do not always speak of them. Sometimes we consider these achievements to be nothing out of the ordinary. Such is our time — the time of great accomplishments and heroic deeds; such are our people — ready to do anything in the name of the beloved homeland. But this does not lessen the achievements; they do not lose their moral strength and do not cease to characterize the beauty of the soul of the soldiers and rocketeers.

Deeds are performed every day, when the rocketeers study and when they relax, when they are on combat duty or when they are engaged in routine army activity without which ordinary army life is inconceivable. Many army rocketeers have already been awarded orders and medals for noble deeds in the name of the homeland; their deeds were recorded by the Central Committee of the Lenin Komsomol; and they received valuable presents. Some of them were suitably rewarded for their achievements in mastering the complicated technology; others performed heroic deeds and also received high rewards.

They all deserve to be known to the Soviet people, but it is impossible to relate all the heroic deeds of the soldiers. Only some will be described.

Komsomol member Yurii Nekhai was serving in a certain unit. His comrades liked him for his diligence, his happy disposition, and his pleasant singing. No one ever saw him idle. When marching, he led the singing; at work he was an example of diligence. He was excellent in combat training. During his few minutes of rest he entertained the others. "An outstanding son of the Tartar nation" — that is how he was described lovingly by the small circle of soldiers who served with him.

It was in the second year of his service. The tense army life never seemed difficult for the soldier. This time, too, the soldier was fulfilling one of the assignments given him by the commander. Suddenly he smelled something pungent. The well-trained soldier immmediately realized it was a special and very valuable liquid. "But where is it coming from? Perhaps there has been an accident in the storage tank!" Without hesitation the young communist rushed to the storage tanks. So it was — there was a large leak in the nearest one. Putting on his gas mask, Yurii began to combat the sudden danger single-handed. Despite his immense efforts the liquid continued to escape, and a great concentration of the gas formed in the air. The gas mask was damaged and became useless. His life was in danger. Nekhai was fully aware of this but he continued his fight. Comrades who rushed to the spot helped to finish the work. But Yurii was not fated to enjoy the fruits of his effort: after some time he died from the effect of the gases which had penetrated his body.

The Presidium of the Supreme Soviet of the USSR posthumously conferred the Order of the Red Star on Yurii Maskhudovich Nekhai for his outstanding deed.

The following occurred once in an air-force unit equipped with rocket-carrying aircraft.

Alert! The young pilot First Lieutenant Igor Ancheev quickly took his place in the cockpit of the fighter plane and reported that he was ready to

perform his task. A moment later he received the order to take off. The silvery bird quickly rushed along the runway, and began to rise higher and higher.

"Amber, Amber, this is Three-seventy-two, ascended to specified altitude," pilot Ancheev reported after a few minutes.

"Three-seventy-two, Three-seventy-two — look out! The 'enemy' is on your right," the ground replied.

"I see the 'target' and I will attack," the pilot reported and went in to attack.

Having completed his task, Ancheev turned his plane around and set course in the direction of the airfield. He was in a good mood and the gay pleasant tunes he had recently heard in a radio concert passed through his mind. Suddenly the sky darkened. The ground, which had been so clearly visible only a minute ago, was obscured by clouds. The pilot sat up: "This will be a difficult landing."

Having reported the situation and having received permission to land, Igor began descending gradually with his aircraft, hoping that he would quickly pass through the clouds. However, this was not the case — the clouds were descending quickly. The commander was just about to order the pilot to land at an emergency airfield when the pilot reported:

"The red light went on."

That meant that the fuel was running out and there was no chance of flying to another airfield.

The ether became ominously quiet. The commander was deciding. Every second seemed an eternity.

"You have permission to eject yourself," the quiet resolute voice of the commander was heard.

Igor Ancheev fully understood how difficult it was for the commander to arrive at such a decision. He remembered various discussions between the commander and the young pilots concerning the responsibility for the expensive equipment, and his patient instructions of action to be taken at difficult times to save one's own life and the aircraft.

For the pilot it was difficult, too, to abandon the aircraft. How many tasks had he fulfilled 'excellently' on his impetuous and obedient machine. And now he himself was supposed to destroy it. "No," the pilot decided, "I will fight to the end."

And he replied to the ground:

"I am going to land. The engines function normally. I feel fine."

However, after a few seconds it became quiet in the cockpit. "Now the engines have stopped," he thought, "the fuel has run out!"

"Amber, Amber! This is Three-seventy-two. The engines have stopped; I am descending."

With the special sense which pilots have, Igor guessed that the airfield was nearby. "I have to make it at any cost," he ordered himself. "Only a little more."

With an accustomed movement Ancheev depressurized the cockpit, and in the silence he heard distinctly how the wind blew strongly outside and heavy wet snow lashed the plane.

Ancheev pulled for all he was worth. The self-control that army life had taught him, and the training he had received in the flying club, in the

military school, and in his regiment now served him well. It seemed that the tension had reached a peak. His face was covered with sweat. His muscles seemed to be filled with lead. His eyes began to hurt from the constant straining. One minute passed, then another, and suddenly the searchlight beams appeared, hardly visible at first, like ghosts, and then more and more clearly. Under the plane the runway was clearly visible. A sharp blow as the wheels touched down on the concrete, and then the plane rolled smoothly along the airfield. Great skill, acquired throughout years of service, courage, valor, and endurance were victorious.

His colleagues surrounded Ancheev to shake his hand. Soberly but with undisguised joy the commander congratulated the courageous pilot.

The story of Igor Ancheev's deed quickly circulated through the anti-aircraft defense forces. After a few days he was received by the commanding officer who congratulated him heartily on his unblemished service and rewarded him by promoting him to the rank of captain. A few days later the courageous flier had the medal "For combat merit" pinned on his chest.

Now Captain Ancheev will fly rocket-carrying planes even better and with greater confidence. His skill, fighting experience, and awareness of the great responsibility for a given assignment serve as a wonderful example for the young airmen.

The heroic profession of airman, especially when he flies modern rocket carriers, inspires great deeds by its own virtue. But the soldiers serving in seemingly more modest professions are also capable of valorous deeds, even in peacetime. It is not without reason that they are rocketeers.

The unit in which Private Ilsur Khafizov served as driver of a combat vehicle received the urgent task of transporting very important goods. The drivers started their engines quickly and the convoy moved off. The slippery snow-covered road was winding through woods. But great experience and skill of the drivers acquired through training made it possible for the convoy to advance quickly and without trouble. When there were only a few kilometers left to their destination, a river intersected their road. According to the training plan the bridge had been "bombed and destroyed."

It was decided to make the crossing over the ice. Who was to go first?

Khafizov was chosen. He had long been recognized by his colleagues as an expert capable of driving under any conditions. Now was the time to confirm his skill by deeds.

The heavy truck moved smoothly over the snowy plain. Two hundred meters from the bridge it drove onto the ice and moved toward the opposite bank. One meter, two, three meters. It seemed that the ice would hold. But suddenly there was a bang and the truck began to sink into the water rapidly. Khafizov managed to jump out of the cab of the truck, and he stood at the hole in the ice, shaken by what had happened.

He had to solve the problem which had arisen. Should he leave the truck and continue the journey, or hold up the convoy, pull out of the truck, and then continue with the assignment?

The difficult problem was solved suddenly and unexpectedly — Ilsur Khafizov, having quickly made up his mind, took a tow and dived into the cold water. His first attempt proved to be futile. His body was numbed by

the cold and it seemed that nothing could make him dive again into the icy water. But his will power got the upper hand. A moment passed and he again dived into the water. This time he stayed longer under water and achieved his purpose. The towline was safely fixed to the submerged truck. To pull it out from the river was easy now. The truck with the valuable load was saved. The convoy crossed the river safely at some other point and arrived in time at the destination.

All over the immense territory of the Soviet Union the Soviet soldiers stand guard. They learn persistently to become skilled fighters. Love for their country and loyalty to their military oath inspire them in their selfless military work.

The rocketeers do their duty with the knowledge of their enormous responsibility. They fully realize that under present conditions they are the first-line troops.

THE ROCKETEERS LEAD IN EVERYTHING

It is no exaggeration to say that the rocketeers who are soldiers of the most modern arm set the pace in many things: they are in the forefront of the struggle to increase the number of excellent soldiers and qualified specialists, and they exemplify selfless work in mastering the latest achievements in scientific knowledge. They especially initiate patriotic deeds which generally develop into mass movements and are a significant factor in the indomitable growth of the might of the Soviet Armed Forces.

An innovating spirit, boundless energy, patriotism, and the striving for thorough knowledge of the formidable weapon, entrusted to them by the people — these are qualities that characterized the rocketeers from the first day this armed branch was created.

It was correctly assumed that the new weapon could be most effectively employed only if thorough training would be given to entire crews, detachments, squadrons, and units, as well as to individual soldiers. With a view to this the Rocket Forces immediately prepared for the training of excellent crews and detachments. The motto "Every unit has excellent crews and detachments" became the fighting motto of the rocketeers. This was the first step in the struggle for excellent detachments and units.

Soldiers of the Rocket Forces participating in the All-Army Conference of Komsomol workers (1961).

Here is a typical example. The unit in which Captain Yu. A. Rozanov served once received a new rocket weapon. Although they all anticipated its arrival, that day it came unexpectedly. Having inspected the powerful weapon, some soldiers doubted the possibility of learning to handle it

within the time allotted by the commander. However, this first impression, as others, proved to be fallacious. The commander, who had spent the entire war in a Guards mine-thrower unit, knew from his own experience that something new always evokes doubts, but that this passes with time. More emphasis on study was all that was necessary for them to learn how to handle the weapons.

In solving the problems of training, an important part is played by the Party organization. The communists decided: "Every Party member will acquire excellent technical knowledge." The Komsomol organization adopted a similar motto.

The communists and Komsomol members implemented their mottoes by actual deeds. On the initiative of the secretary of the Party bureau they decided to organize theoretical conferences. The members of the Komsomol found a new way of disseminating technical knowledge: technical evening sessions and quiz games. Innovators among the soldiers spent much effort and work on equipping classrooms in which everyone would be able to observe, on working models, the physical processes involved in the complicated machinery.

The commander paid much attention to the competition.

The soldiers took an active part in the struggle. Day and night one could hear thunderous commands, determining the activities of the crews. Neither snow nor frost slowed down the combat training of the rocketeers. From day to day their work improved and they became more skillful. They learned to work excellently under any conditions. Moreover, some outstanding pioneers appeared who took it upon themselves to work at night according to norms fixed for daytime, and to work in winter according to summer norms.

The allotted time elapsed. The competitions in the lower units ended. The best soldiers were nominated and chosen to enter the final round of the competitions.

A freezing, windy morning. At the firing position, in the midst of a dense, snow-covered pine forest, the soldiers, sergeants, and officers assembled. They were impervious to the frost. All their attention was riveted on the work of the foremost crews.

"Switch on the alarm signal!" the chairman of the commission ordered. Immediately the frosty air was filled with the rich bass sound of the siren. This was the signal for the first crew to start.

The soldiers, who were in the shelter, quickly took up their combat positions. One, two, three seconds, and they had already put on their protective suits and donned their gas masks. This was in accordance with the rules of the competition. Rapid, almost acrobatic movements, and the silvery rocket was unwrapped. A few more skillful procedures, repeated until they became automatic, and the report followed:

"Rocket ready to be lifted!"

Thus ended the first stage of preparing the rocket for combat.

Then the crew commander switched on a power unit. The electric motors hummed, and the cables worked noiselessly, sliding in grease. The rocket shuddered, and then its nose began rising slowly into the air. The crew members performed a number of new operations in the meantime.

They did everything necessary for the rocket to be exactly in position as soon as it attained the required angle.

Making certain that the rocket was in the required position and reliably fastened, the commander gave the next order:

"Withdraw the pins!"

Freed of the pins, the rocket did not move an inch.

"This is excellent," one of the watching men said.

A dexterous movement by one of the crew members, and the launching plug was firmly fixed in the socket. All that was needed now was to press a button, and the rocket would fly toward its target.

The stop watches clicked, and calculations were made. The result was excellent. The crew surpassed the summer norms under winter conditions, without making any mistakes.

Similarly one crew after the other, in daylight and at night, demonstrated its skill. The result proved to be astounding. More than half the crews had exclusively excellent results, and the rest were classified as very good.

At a solemn ceremony the commander announced the results of the competition in front of all the men, and then he handed out the prizes. Corporal Akhmetshin and his comrades received the first prize: passes enabling them to visit their homes,. and also a flag. A car was waiting for them and took them to the nearest railroad station.

Such well-organized socialist emulation inspired the people, and made them confident that they would attain excellent results. Consequently, at the end of the school year sixty per cent of the crews were classified as "excellent," and the rest were "very good." On the order of the day came the task of turning all the crews into excellent ones.

But would the soldiers be equal to such a task? After all, there was no precedent of an entire unit of rocketeers being classified as "excellent."

The soldiers decided to strive for their goal. They had a basis for reaching it. The rich experience of the past year and the successes attained in schooling provided a reliable foundation on which it was possible to proceed toward the desired goal.

First a detailed schedule of the use of the rocket models for training the combat crews was prepared. As a result, the time allotted for technical work was better utilized. Whereas before the routine work seemed to be carried out for its own sake, it now became a means of teaching. Engineers and the technicians who were themselves being trained, explained to their subordinates methods and purposes of what they were doing while checking and dismantling instruments.

Days, weeks, and months passed, filled with combat training. Each day of training was analyzed. Shortcomings were revealed and remedied on the spot. The best and most advanced experience of a few became the property of all. A merciless fight against convention and indulgence was waged.

The determined struggle of the rocketeers soon yielded the first results. They finished the winter period with excellent classification. The best proof of that was the successful combat firing exercise.

The first successes raised the morale of the personnel even higher. Even the skeptics (and there were some also this time) were convinced that the task given to the personnel would be fulfilled.

Late in autumn the unit underwent a check. The generals and officers of the higher command made a searching test of the combat readiness, combat training, and military discipline. There was no trace of leniency. The commission knew very well what a responsibility it took upon itself in assessing the combat readiness and political preparation.

Attentively, even fussily, the inspecting officers observed the action of the crews. Their inquisitiveness bothered the soldiers. Finally the question of the primacy in the competition was being decided. Here too, not only minutes, but every second could be the one that would either bring the joy of victory or the bitterness of defeat.

So far all operations were carried out ahead of schedule. This was the conviction of the platoon commander First Lieutenant Basala. He felt the great speed at which the work was being done. Would it be possible to maintain this speed until the end?

Now came the most difficult and decisive moment: the hoist with the rocket approached its vertical position. In a moment the rocket would stand upright in its place. But at that instant something went wrong. The officer saw that the coupling which fastened the rocket to the hoist had not been loosened.

What negligence! They would have to lower the rocket and then lift it again. That would mean a considerable loss of time.

Corporal Goryaev noticed the first lieutenant's glance. Goryaev's ears went fiery red; in his eyes there appeared a feverish brightness.

"May I?" he took one step toward the first lieutenant.

After one word the officer understood what the NCO was up to.

"Permission granted."

Goryaev snatched an A-shaped ruler and hurried to the hoist. The wind beat his face, and rocked and pulled at him, but the courageous soldier climbed ever higher. Now he reached the coupling, and a moment later he had removed it.

The norm for preparing the rocket for firing had been surpassed. The examining officers did not even notice the trouble that had developed at the launching position.

The unit was classified as "excellent." It was one of the first "excellent" units, not only in the Rocket Forces but in the entire Armed Forces.

In recent years new excellent units appeared in the Rocket Forces, and the level of preparation classified as "excellent" has become the rule.

Thus a good action, having begun in one unit, revealed new possibilities of technical training, and of further improvement of combat readiness of the Rocket Forces.

The rocketeers are very inquisitive. They are never satisfied with what they have achieved, and always search for and find new ways of further development.

The reason is clear. In connection with the most sophisticated weapon the requirements imposed on the soldiers and on their technical knowledge grow. A deep understanding of this fact was the basis on which a patriotic movement was founded in the rocket units of the antiaircraft defense in the Moscow District. Its goal was units of uniform and high qualification, meaning a level of combat readiness at which all soldiers are skilled specialists, and all warrant officers and officers specialists are rated as first or second class.

The initiators of this noteworthy movement were the communists in the unit in which Captain Makarov was, at that time, secretary of the Party organization.

The problem was undoubtedly difficult, but its solution was made possible by: a sound economic base, the patriotic movement among the soldiers, sergeants, and officers of the Rocket Forces, excellent training, and tough cadres of commanders who know their jobs well.

Having committed themselves to this bold undertaking, the communists and Komsomol members among the rocketeers assumed, firstly, that their unit would be among the foremost ones for several years. There was not a single case of unpreparedness for combat with the weapons. In tactical maneuvers the personnel always showed a high degree of combat skill. Secondly, even at that time many soldiers, sergeants, and officers had attained a high qualification rating.

At a public meeting the communists and Komsomol members suggested concrete measures for the mobilization of the personnel.

The valuable initiative of the rocketeers was recognized by the Military Council of the district. The military commander in his order highly valued the new patriotic initiative and made it the duty of all commanders and political workers to support this movement and to create the necessary conditions for its successful realization.

Priding themselves on their initiative, the soldiers, sergeants, and officers went to work even more determined to increase their technical knowledge. Of course, as with every great undertaking, there were obstacles. At first some soldiers did not study the apparatus and instruments entrusted to them with sufficient thoroughness, and a few were downright lazy. However, this could not escape the watchful eyes of the other soldiers. Those lagging behind were helped by the stronger ones, and downright shirkers were hauled before assembled soldiers, and having been put to shame by their comrades, they made up for what they had neglected.

Thus the foremost rocket unit of high qualification was born. For the successes attained in combat and political preparedness, and for high military discipline its members received a red banner.

Still more and more units joined the movement of emulation for high qualification. Soon the initiative of the rocketeers found wide support among other arms and caused a further increase in the might of the Soviet Armed Forces.

Even with that the army rocketeers were not satisfied. At a Party meeting of one of the units the problem was raised: "What can be done to ensure that the unit will remain fit for combat even if some of its engineers and technicians are incapacitated as a result of military action?"

There were several suggestions. Some said that if even one engineer was incapacitated, it would cause great difficulties. It would be impossible to ensure that all the technical equipment was maintained in perfect order. Others were firm in their conviction that this could not happen. There was one solution: a situation had to be created in which every engineer knows perfectly not only his own, but also the adjacent specialization, that every technician learns to replace an engineer, and every sergeant and soldier can work at a technician's level.

The bold idea of the communists soon acquired actual strength. The commander issued an order and the new undertaking became reality.

Soon it found a widespread response, encompassed all the rocketeers, and yielded the desired results. By now it is not unusual in the Rocket Forces that an engineer is an expert in two or even three specializations, that a technician successfully replaces an engineer, and that many sergeants and soldiers work skillfully as technicians.

Convoy on the march.

Like many other officers, Captain Antonov came to the rocket unit from another branch of the army. He had very good general training and fairly thorough technical knowledge, and so the officer soon became thoroughly familiar with the instruments entrusted to him; he also began to take an interest in the instruments which were used in conjunction with his, and after some time he became familiar with them, as well.

The knowledge and experience he acquired enabled him to pass his examinations with the highest marks. In the third year of service Antonov was the first to receive the coveted title of master. In view of the officer's keenness to acquire new knowledge, the command appointed Antonov to the post of engineer. The inquisitive officer successfully coped with his new duties.

A technician by the name of Zolotarev was also fully confident in his responsible position. He unceasingly strived to learn new things. The officer got hold of a textbook dealing with rocket engines, written for students of the academy. He studied it for a month. Although he did not understand everything, his studying had not been in vain.

Once, when a rocket was being prepared for launching, the engine developed some trouble. It was a tricky business. It was even beyond the power of an experienced engineer to correct the fault. But Zolotarev proved to be equal to the task: he made the right diagnosis. Within a short time he located the trouble and corrected the difficulty. His subordinates began to look upon him as an accomplished specialist.

Many genuine masters of their craft can also be found among the soldiers doing active service. One example is Corporal Kapustnik. He is the most highly respected man in the unit. He initiated many good actions. His technical knowledge is superb. Another example is Private Mazurenko. He already exhibited a creative vein and love of technology while in high school. This enabled him to become quickly acquainted with the duties of every member of the crew.

The complicated technical apparatus with which the rocketeers have to deal also determines their range of interests to an appreciable extent. The soldiers love technical books, but unfortunately their library is not very large. Everything has been read many times. In the commissary the soldiers never pass up a new and interesting book. The rocketeers follow avidly all the achievements of science and technology in the world, and they are acquainted with many scientific problems. If something goes wrong with the instruments entrusted to them, the fault would be located within a few seconds.

Combat training was in full swing. The first class operators, Corporals Todoseichuk, Panfilov, Sergeant Sorokin and others detected aerial targets from a maximum distance and held them securely. Suddenly the bright point on the screen disappeared. "Something seems to be out of order" thought the operators.

It was necessary to quickly determine the cause of the trouble in the instrument and to correct it. That could be done only by someone who knew thoroughly and in detail the complicated apparatus and was used to operating it.

A few minutes passed, and First Lieutenant V. Koval'chuk found the faulty one among many tubes and replaced it. The instrument again worked flawlessly.

Even in peacetime the rocketeers fulfill responsible combat assignments. They are fighters of the first line of defense. That is precisely why every day of their strenuous study may bring something new and valuable. Not so long ago they led the struggle for raising the level of combat training, and then they worked hard so that the soldiers would learn allied specializations. Now the fight to achieve mutual interchangeability has become a tradition among the rocketeers.

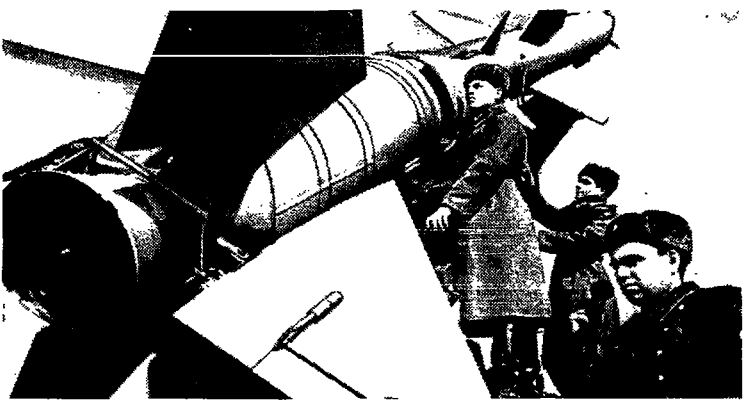
The soldiers of the rocket forces understand perfectly that in a rocket and nuclear war it is particularly important to be able to replace quickly a comrade who has become incapacitated, not only if he works at the adjacent apparatus, but also if he is engaged in completely different work. That is the reason why in many units the soldiers and sergeants, having become excellent operators, can successfully work in the place of any member of the launching crew. The locator men made a thorough study of the duties of the operators. The men of the rocket crew can successfully work as locator men.

A noteworthy tradition of the rocketeers has also become the constant creative quest, aimed at improving the combat possibilities of rockets. Thus in the unit in which an officer by name of V. I. Bezuglykh served, the soldiers constantly contemplated the construction of an instrument which would help in the objective assessment of the work of crews in actual fighting, which would record their results, and would make it possible to analyze thoroughly the activity of every operator afterward in order to find every mistake that had been made. Such an instrument was finally designed by virtue of the persistent efforts of the soldiers, and it has helped in many aspects of the training of highly-skilled and specialized rocketeers.

It is well known that with the existing means of transport of the contemporary destructive weapons the rocketeers have to count every second. The struggle for saving time is therefore of great importance.

The rocketeers have learned to work skillfully and quickly at the sound of an alert. All in all only a few minutes pass after the siren has sounded, and the soldiers, sergeants, and officers have already taken up their combat positions, switched on the instruments entrusted to them, and after the necessary time for their warming up, they prepare their apparatus for combat.

It goes without saying that here all the possibilities have been exploited and nothing remains to reduce the time required for preparing the instruments and rockets for combat. The time for warming up the instruments for the weapons cannot be reduced. Even a simple television receiver has to warm up for 3 to 5 minutes before the picture appears on the screen, and it contains fewer tubes than a contemporary radiolocator or a rocket instrument. It is also impossible to speed up the appearance of the crew after the alert has sounded because the soldiers already act with the speed of lightning.



Training with the rocket.

However, the rocketeers found a solution. They decided to combine two processes into one. Not much was needed to do that. Whereas before each operator switched on his instrument independently, now, as a result of some improvements it became possible to switch on all the instruments simultaneously. As soon as the alert is sounded, the man on duty operates a master switch, and by the time the crew arrives, all the instruments are warm and ready for combat. The result was that a few more valuable minutes were gained.

The operators also contributed their share to the struggle for seconds and minutes. However, here the main thing was not technical improvements, but superb combat training, resourcefulness, and boldness.

Each locator station has its tactical and technical data, determined by the designers during the testing at the central firing ranges. Every

operator is obliged to fully exploit the tactical and technical potential of the station, and to learn to detect targets at previously designated distances. That is what they are actually taught by their commanders. But is it not possible to go beyond the tactical and technical data — cannot the stations be made to detect targets at greater distances than designated in the specification? It was found that this is possible. It was only necessary to adjust the instruments very accurately and to give the operators higher training.

The first to do this were the soldiers commanded by officer Kuznetsov, and then the operators of other units followed their example. Thus some more valuable minutes were gained for preparing the rockets and instruments for combat.

The sources of the creativity of the rocketeers are certainly inexhaustible, and it is impossible to list all their patriotic undertakings. One thing is certain: the rocketeers do not stand still. They constantly improve their skill and rocket techniques.

Instruments and machinery now perform many duties formerly discharged by people, making their work easier. But whoever thinks that nowadays it is easy to destroy the enemy by simply pressing a button, is mistaken. Rockets depend on strength, skill, and endurance. There is no room for the feeble next to them. Anyone who has ever been to a rocket site will readily understand this.

Oaks and birches grow close to the military camp. On a clearing in the wood is a training site, in the center of which is a launcher.

"We are preparing for firing," the battery commander, Captain Zakharov, explains. "We are training the crews in charging and discharging under simulated combat conditions."

The crews stand in single rank. One of them is in the shelter. Captain Zakharov, well-built, slim, with energetic movements, gives instructions to his subordinates and tells them to observe the actions of their comrades closely. Then he takes his place on the right flank and issues orders.

One after the other the rocketeers run from the shelter and hurry toward the launcher. It is not far, but everyone understands that in order to charge the launcher within the shortest possible time, it is necessary to cover this short distance as quickly as possible; the two or three seconds thus saved may later prove to be significant. From the way this crew executes the maneuver it is obvious that the soldiers are well-trained. A sergeant runs in front. He is Trachuk, the crew commander. Two corporals, Tropin and Nazarov, follow behind him easily. Private Bubnovich brings up the rear. The rocketeers have already crossed the small plain and are taking their positions by the launcher. The commander signals to Private Syursin, indicating that he is to go into action. He quickly feeds the rocket to the launching pad, exactly where it is required. It was not an easy drill to learn, for here, too, every second counts.

The seconds are precious! As soon as the rocket has come to rest at the launching pad, the crew members take their position next to it. Corporal Trachuk, having received reports from his subordinates, now gives the order to charge.

The battery commander and the soldiers of the other crews watch their colleagues work. The captain looks at the stop watch. The second hand moves in jerks around the dial.

The rocketeers work well together; they act efficiently, without getting in each other's way. Private Bubnovich has released the front coupling. Corporal Nazarov has instantly removed the support from under the rocket. Corporal Tropin, standing next to him, has snatched away the jack.

At last the rocket is ready in its position on the launching pad. Captain Zakharov's face brightens. The officer clicks the stop watch. The crew saved 20 seconds. Their rating is "excellent"!

However, the commander, who knows the duties of each man thoroughly, having himself charged launchers more than once as a crew member, did not miss a single error made by his subordinates. For example, he noticed that one soldier gave his report too late, resulting in a loss of two seconds. Thus, the outcome could have been even better.

After that the crew discharged the launcher as quickly. The rocketeers received high marks.

All in all only a few minutes passed since we saw the rocketeers run from their shelter. Now they wipe the sweat from their faces. Much work has been done. No wonder the tunics on their backs have become dark. It is difficult to gain seconds! They can only be saved if combat training is complemented by physical fitness.

During the intermission Captain Zakharov describes how the soldiers of his battery attain their success:

"In our camp there are limited facilities for physical training and sports. However, we do everything in our power to ensure that the soldiers' physical fitness continuously improves. Our sports ground is never empty. We run cross-country races regularly."

The soldiers of the battery go in for sports and physical training. The battery commander and the sports organizer Lieutenant Morozov can arouse an interest, and even enthusiasm, for sports in anyone.

Seventy per cent of the soldiers in the battery are active sportsmen, which indicates that the NCO's and officers work with foresight and deliberation. It is not accidental that the best specialists in the battery, Trachuk, Rodichkin, Latyshev, Tropin, and Bubnovich are also outstanding sportsmen.

After the intermission the competition continued. The second crew took its place at the launching pad. Again a rocket was supplied, and the adroit hands of the rocketeers charged the launcher. The stop watch once more registered an excellent time.

Captain Zakharov made the training more and more complicated, and imposed conditions similar to those that might occur in actual combat. Certain shortcomings were revealed and corrections made, but the results remained invariably good. The NCO's and soldiers were up to the mark. All the rockets were prepared for launching; the work was done well and in good time.

The rockets respond best to soldiers who know their job. In addition, the rocketeer has to be bold and ready for various surprises because of the many difficulties involved in modern warfare. The enemy may also use missiles with nuclear warheads. How will the rocketeers behave if a nuclear explosion takes place nearby?

The history of warfare proves that with the development of increasingly deadly weapons the morale of the troops on the battlefield must improve as well. If people would have to withstand a terrific tension at the decisive moment, and if the troops would have to overcome the consequences of a nuclear attack within a short time and continue fighting, their training would have to be thorough. Obviously this training should take place under conditions resembling those of actual combat as closely as possible.

Just recall the first unexpected use of chemical weapons, the first tank attack, the first sudden mass air raids in previous wars. At first each of these new weapons ensured great success, but gradually the soldiers overcame their fear, and learned to fight against such weapons.

Remember the fear of tanks. During the first months of World War II there were cases of soldiers deserting the battlefield when tanks attacked them. However, as early as autumn 1941 the Soviet troops had already repulsed enemy tank attacks with firmness.

What happened within this short time? Much educational work was done among the soldiers. Whenever there was a breathing space in the fighting, small units were withdrawn from the front, the operation of grenades, bottles of inflammable liquids, and armor-piercing shells was demonstrated to them. The targets were captured German tanks. The soldiers saw how tanks could be destroyed by the simplest weapons. Entire detachments were positioned in trenches while tanks passed overhead. The soldiers realized that it is possible to take cover effectively when tanks threaten, that they can be successfully combatted. The fear of tanks was overcome.

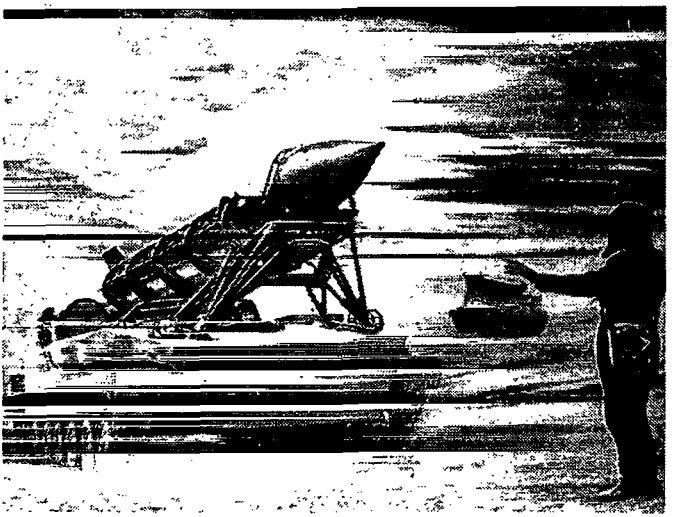
During combat training it is impossible to use real nuclear weapons. However, the soldiers have to be trained and educated in the spirit of constant readiness to overcome the consequences of a nuclear attack. This is what is actually done in the rocket units and detachments.

A column of rocketeers quickly crossed the field. The unit was on its way to the "combat line." Suddenly a huge ball of fire and smoke erupted ahead — a "nuclear explosion." The column stopped. The commander sent a radiation reconnaissance to the front, and then issued new dispositions. All the soldiers donned protective clothing and prepared to cross the contaminated zone. It would have been possible for the column to continue directly on its way, but the commander considered the consequences that an actual nuclear attack might have. Radio communications would certainly be disrupted. The grove which lay in the proposed path of the column would be on fire. Obviously, the inhabited area would be destroyed and a large stretch of the road would be difficult to pass.

The commander took all this into account and ordered the soldiers to use every available means to re-establish the broken communication. Then, he took steps to determine the number of people and weapons which had survived the nuclear explosion and were able to fulfill the given combat task. The officer made a new combat distribution of the detachment, appointed new commanders to replace those among the casualties, took stock of the transport and combat vehicles, weapons, and material in view of the new situation, and issued more detailed orders concerning the fulfillment of the given task.

The commander appointed a small detachment to extinguish the fire in the grove through which the main road led, and also sent a scouting party

to find a way around the affected area. Rescue work and aid to the wounded were organized.



The rocketeers moving to a new launching site.

The rocketeers did all that was necessary quickly and exactly, and moved on so as to be able to attack the "enemy" within the shortest possible time.

This is how the combat training of the rocketeers is conducted. In the course of this training various patriotic undertakings are conceived, and the soldiers thoroughly learn the methods of armed struggle while using the latest weapons.

All the patriotic deeds, the creativity of the masses of servicemen are inspired by the communists and Komsomol members. They are the nucleus around which the soldiers unite; they mobilize them to perform new outstanding deeds for the sake of raising the defense capability of the country.

The huge wave of socialist emulation, which had originated in the Rocket Forces in honor of the 40th anniversary of adjoining Lenin's name to the Komsomol, spread like an echo throughout all the armed forces. Thousands of soldiers participated in the great march of youth to master Lenin's theoretical legacy and to raise the combat readiness of rocket units.

In a certain rocket unit the soldiers are getting on well with their service. Every other rocketeer is an excellent soldier; more than two thirds of the Komsomol members are qualified specialists; many of them have mastered the adjacent specialization or have become excellent sportsmen. But the Komsomol members are not satisfied with this. They are constantly searching, zealous, and daring.

The Komsomol members of that unit decided to be the initiators of a new patriotic undertaking which they called the Lenin Relay. It was to be held in honor of the 40th anniversary of the day on which Lenin's name was given to the Komsomol.

The initiative of the Komsomol rocketeers inspired many people to participate in the developing movement for a dignified celebration of the anniversary, and became a tremendous stimulus in the further struggle for increased political, military, and technical knowledge of the servicemen. This movement transcended the boundaries of the Rocket Forces — all the Komsomol organizations of the Soviet Army joined it.

Inspired by the Komsomol Relay, the rocketeers, in cooperation with all the soldiers of the armed forces, worked even harder to fulfill their tasks, and to boldly overcome difficulties connected with the exacting military service. Here is one of many examples of a working day of the Komsomol members in the Rocket Forces.

Sergeant Liventsov is well-known in the unit. He is the secretary of the battery Komsomol organization and a highly skilled specialist. He has four decorations on his chest. In the unit they say: "One Liventsov is worth three other soldiers." And this is in fact the case.

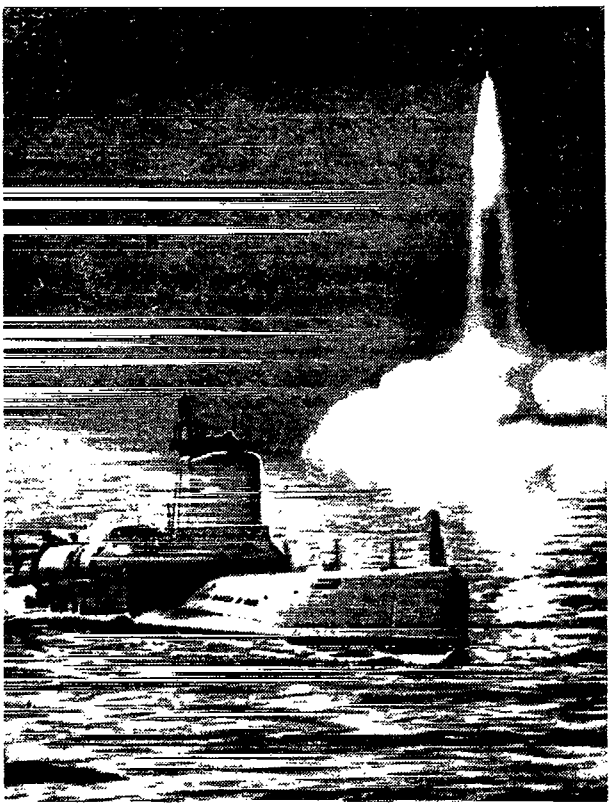
The sergeant has a restless disposition. In combat training he is one of the best. If he makes up his mind to do something, he does it excellently, and he finishes what he begins. He always keeps his word! He took upon himself the socialist obligation of making the crew an excellent one. This was not easy to accomplish, but together with his comrades Liventsov attained his goal. Day and night the soldiers worked untiringly to improve their combat skill. Sometimes the training was continued during their free time. No time was wasted. The crew learned to work fast, and to surpass the norms. Each soldier learned to fulfill the duties of any crew member. The dream of the rocketeers was realized. The crew became an excellent one. Privates Saenko, Kambarov, and others became skilled craftsmen and received three decorations.

Soon the excellent crew had to demonstrate its skill in actual practice. During tactical training it had to solve complicated problems, but this did not deter the skilled soldiers. They were well-prepared to cope with all sorts of unexpected trouble. After an alert, even when encumbered with protection against chemical warfare, they often surpassed the given norms.

"This is our first contribution toward the Komsomol Relay," Sergeant Liventsov said. "But we will not stop there; we will continue to improve our fighting skill ceaselessly."

On 12 July 1964 the Komsomol Relay came to an end. Its participants reported to the command and to the Party organizations that in the course of the Relay it became obvious that the units were comprised of excellent soldiers, skilled craftsmen, and accomplished sportsmen, and that combat preparedness had improved and military discipline had been even further strengthened.

The winners of the Lenin Relay met at the Komsomol Central Committee, and were received by the Main Political Administration of the Soviet Army and Navy. The soldiers, members of the Komsomol, expressed their wish to continue this form of socialist emulation. And in fact, in reply to this wish a new wave of youthful initiative arose. This time the first torch of the Relay was kindled by the young sailors of the Northern Fleet.



Training at sea.

"Krasnaya Zvezda" printed an open letter by the crew of the nuclear submarine "Leninskii Komsomol," addressed to all the youth in the army and navy. The sailors, NCO's, and officers of the famous nuclear ship, the members of the Communist Party and the Komsomol came forward with a new patriotic undertaking. They proposed to all the young soldiers in the army and navy to begin a new relay of outstanding deeds in honor of the coming 9 May 1965, the twentieth anniversary of the victory of the Soviet people in the Second World War.

True to the fighting traditions of the Soviet people and its brave armed forces, the sailors, NCO's, and officers of the nuclear submarine "Leninskii Komsomol" initiated the Relay, by taking upon themselves exacting obligations.

"We promise the beloved Party and our people, the war veterans" the appeal says "that always and in everything we will be steadfast fighters for communism, we will be worthy of the great deeds and accomplishments of our heroic fathers.

"We want to prove our faithfulness to the sacred fighting traditions of the Soviet people and its brave armed forces by concrete deeds. In honor of the coming twentieth anniversary on 9 May 1965 of the great victory

of the Soviet people over Hitlerite Germany we initiate a new movement, a new relay of outstanding deeds, a relay of military glory. Announcing our participation in this relay, we, the sailors, NCO's and officers of the nuclear submarine 'Leninskii Komsomol' undertake the following socialist obligations:

1. To carry high the banner of an excellent ship. By maintaining all the technical means and machinery of the vessel at the highest level of combat readiness, we will enable all members of the crew to become skilled specialists, excellent in combat and political preparation, by 9 May 1965.

2. To learn to work and live in a communist manner. Strictly adhere to the principles of the moral code of the builders of communism, in order that they will become the standard of behavior for every member of the crew.

3. To be worthy heirs of the fighting traditions of the Northern sailors. To foster in every crew member high moral and fighting qualities which are indispensable for victory in present-day warfare. To ensure that every sailor has a thorough knowledge of the history and fighting traditions of the Soviet Armed Forces, of his vessel, and that he maintain these traditions and add to them by his everyday work. The communist and Komsomol members of the crew will untiringly struggle for the right to call themselves the successors of the masters of the war years: the Northern sailors Shumikhin, the acoustician, Zaitsev, the electrical engineer, Gandyukhin, the helmsman, and Chernavtsev, the engineer.

4. To have on the vessel by 9 May 1965 ten masters of the military art and as many men highly skilled in two trades.

5. To provide each young sailor with an experienced serviceman who will accept responsibility for raising his qualification one degree by the 20th anniversary of Victory Day.

6. To have 100 per cent of the sailors on the vessel qualify for the GTO* badge and 60 per cent of them qualify as sportsmen.

7. To collect 30 tons of scrap iron.

8. To assist the local Soviet bodies in putting into perfect order memorials, military cemeteries, and graves of Soviet soldiers. To create in the school, under their patronage, new circles for teaching nautical skills. To take an active part in educating civilian youth of premilitary and military age in our revolutionary and fighting traditions.

"We are fully aware that we have undertaken a difficult task, but we will be equal to it for we are the descendants of bold and brave men. We are spurred on by communists, the best and most steadfast among us. We are inspired by the outstanding successes of the Soviet people in the struggle to implement the Party Program, to build communism. That is why we are convinced that we shall honorably fulfill our obligations in emulating the participants in the Relay of Military Glory.

"Addressing you, our friend and comrade-in-arms, we believe that you will listen to us and support us. We call upon you: join the ranks of the Participants of the Relay of Military Glory! Be a worthy successor

* [Gotov k trudu i oborone — Ready for Labor and Defense.]

in the fighting traditions of our fathers' Always be ready to perform heroic deeds in the name of the homeland!

The crew of the nuclear submarine
'Leninskii Komsomol'"

The participants in the Relay of Fighting Glory undertook difficult and responsible tasks: a great patriotic march of the army and navy youth toward new successes in combat and political preparation. However, the young patriots are not afraid in the face of difficulty. They are strong, full of physical energy, and creative energy. They are convinced that they will fulfill all their obligations with honor. For they, too, belong to the famous tribe of the rocketeers.

Rocketeers! Which soldier is not proud of this name? But to be a rocketeer is not easy. Associated with the name rocketeer are very exacting technical training and perfect combat training, tough physical preparation and great personal culture, extraordinary moral endurance and a high sense of personal responsibility for the defense of the socialist state.

A characteristic feature of the life and training of the rocketeers as well as of all Soviet soldiers is the fact that, while keeping in step with life, they not only perfect their military skill, but also improve their moral qualities. In fulfilling their socialist obligations, they strengthen their fighting comradeship and military friendship, but above all else reliability, integrity, truthfulness, diligence, contempt for expressions of vulgarity, coarseness, and disrespect to women. Excellent training and high moral standards — these are the qualities marking the darling of the nation: the rocketeer!

The rocketeers have proved to be worthy of continuing in the best traditions of the past: they preserve them, augment them, and create new ones. They are the successors and continuators in the glorious military deeds of the older comrades and creators of all that is the new and progressive in the difficult art of warfare.

THE ROCKETS FLY INTO THE FUTURE

The Soviet rocket stands on guard like the most reliable sentry to protect peace and the safety of the Soviet Union.

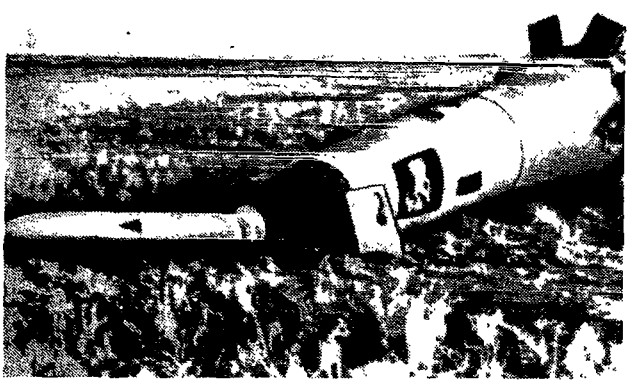
"Show us your rockets which astound the world" ask the Western journalists.

"No," is the reply, "it is still too soon to do that.

"We firmly shut the doors of our rocket garrisons, but anything concerning the peaceful 'Katyushas' is at your disposal — look, learn, profit from our experience."

There are many fields in which rockets find peaceful application. However, the widest use of rockets is made in the conquest of space and in meteorology. This book has already discussed the space achievements of the Soviet Union. It is also worthwhile looking at meteorology.

Rockets have been used for a long time in the Soviet Union for studying the upper layers of the atmosphere. This is of enormous scientific and practical importance. Regular weather forecasts are necessary for agriculture, aviation, shipping, railroad transport, and for other branches of the economy. At high altitudes there is a region of electrically charged particles which reflect radio waves — the ionosphere. The timely prediction of magnetic storms and observation of atmospheric reflecting layers will help to ensure uninterrupted radio communication. The "upper" atmosphere has in recent years also aroused particular attention because the development of aviation and rocketry requires the study of occurrences at high altitudes. There lie the paths of ballistic missiles and rocket-propelled aircraft.



Container with scientific instruments of a geophysical rocket, safely returned to Earth after having fulfilled the stipulated program.

Beginning in 1949, the launching of rockets equipped with scientific instruments, in the Soviet Union, has gradually become one of the main methods of studying the high strata of the atmosphere.

Meteorological rockets now crisscross the aerial ocean in all directions and at the most varied altitudes. There is still another field of application of rockets — against hail! That is why the settlement of the complex expedition of the Geophysical Institute of the Georgian Academy of Sciences and of the Central Aerological Observatory of the Main Administration of the Hydrometeorological Service at the Council of Ministers of the USSR is called Gradograd [Hailtown]. This name is not official but it accurately describes the problems which the scientists have tackled and which they are now solving successfully.

When they began work, many problems arose. In the first place it was necessary to study in detail the physical processes of hail formation and the development of clouds, to learn to determine their hail-bearing capacity and hail hazard, and to clear up a number of large and small questions. When the laws of hail cloud formation had been discovered, it was necessary to learn how to influence the processes occurring in the clouds when they are about to disintegrate into hail, and to determine what happens in the cloud when a seeding agent is injected into it. In other words, to understand how an extraneous substance "creates" hail and forces it to precipitate, not just anywhere, but in a harmless, previously chosen area.

Theory and experiments led to the same conclusion that the basic task was to work out a method of affecting the hail cloud. The rocket was chosen for this task. The most modern and most formidable weapon became the defender of the fields — the changer of nature. A special portable rocket was designed. In 1958 intensive tests began. The results were so good that it was decided to continue them and to create a permanent service for combating hail which by now has 40 rocket stations in the Alazan lowland.

Further tests of rockets are being carried out. The command point was alerted. The wireless operators on duty maintained uninterrupted communication with the rocket stations. The meteorologists and aerologists, headed by Shalva Turkiya, bent over their instruments and maps; the chief of staff of the expedition Archil Okudzhava was waiting impatiently for the initial data from the radar operators. And they, Tomas Salukvadze and Vitautas Lapinskas carefully "probed" the cloud, attempting to determine whether it was hail-bearing or not. Yes, it was hail-bearing! Immediately the coordinates were transmitted to the command point. Archil Okudzhava ordered the rocket stations to open fire at the hail clouds:

"Distance 1,800 meters, height 900. Ten rockets!"

Taking hold of a rocket, our guide Iraklii hurried to the launcher. Three precise movements: supply, positioning, contact — and the rocket was ready for launching. Doubling to the shelter, he ordered: "Fire!"

A hissing, increasingly loud sound rent the air. The rocket was thrust into the cloud, and behind it trailed a smoky wake. The faraway thud of the explosion indicated that it had functioned well. Iraklii carried the next rocket to the launcher. Again a launching, the sound rending the air, the smoky trail, and the thud in the clouds.

After the seventh launching hail began to fall. Heavy and dense, it beat down the grass, rattled the boards of the shelter, and painfully hit the men on the head. But they were all glad.

"It did not get through to the valley! We did not let it" cried Iraklii. "Fall here! We can stand it."

Then the formerly black, thick, heavy cloud gradually became loose, amorphous: its hollowed-out center turned gray, and fibrous fragments detached from the mass. The hail-bearing and dangerous cloud turned into an ordinary rain cloud, which no longer terrified anyone.

An important field of application for rockets, will undoubtedly be transport. There were press reports abroad of a project of a multistage rocket craft with a ceiling of 300-500 kilometers which will be able to circle the earth several times. This design will incorporate elements already known in present-day rocket engineering, in particular powerful engines used in large missiles. Thus the successes in aviation and rocket design justify the conclusion that the construction of a passenger space vessel, which can attain a speed of 8 kilometers per second, is a feasible technical task.

But does this comprise all the uses of rockets in man's life?

"No" say the scientists and designers. "There are still scientific fields in which the rocket has only taken its first steps."

In one of the Soviet laboratories a rather unexpected conversion of a rocket nozzle can be seen. The researchers saw in it the power station of the future. In the fiery tail of the rocket they visualized the fire box as well as the boiler, the turbine, the electric generator — in a word, a mighty means of directly converting heat into electric energy. It was found that it is only necessary to place an ordinary magnet next to the roaring dart of the flame, and their proximity replaces an electrical generator. An electric current originates in the flame.

The flame emerging from the rocket nozzle is the "fourth state of aggregation" which the physicists call plasma. The difference between an ordinary gas and a plasma is that in a plasma an increasingly large role is played by free electrons and electrically charged ionized atoms and molecules. However, plasma is in fact the commonest form of matter. After all, solid, liquid, and gaseous matter forms only an infinitesimally small part of the universe; all the rest is plasma.

The theory of the new generator is based on the theory of plasma. This new science is called magnetohydrodynamics. It is the younger sister of conventional classical hydrodynamics, but its field is much wider. The laws of ordinary hydrodynamics govern four oceans of water and one aerial ocean — the atmosphere; those of magnetohydrodynamics describe the rest of the universe. The laws of magnetohydrodynamics have been literally "sent down from heaven." They derive from the study of the behavior of cosmic nebulae and stellar atmospheres. A magnetohydrodynamic generator without boilers, turbines, rotors, or any moving mechanical part, permitting direct conversion of heat into electric energy emerges before us.

No one knows in which other fields of human knowledge, science, and technology the peaceful "Katyushas" will yet find an application, but one thing is absolutely clear: rockets are not only a scourge, but also man's great friend, helping him to build a new, happy life.

The Soviet Union has not only a firm base capable of solving any problem obstructing the utilization of rockets for the requirements of mankind. It has people who are capable of implementing the solutions of

these problems within the shortest possible time. The Soviet designers and engineers, technicians and workers, the fearless astronauts have demonstrated more than once to the whole world their capability to perform the most daring task.

They have worthy successors. As the blazing progress of aviation gave rise to the development of the airplane-modeling sport, a new kind of technical creativity — rocket modeling — has been inspired by the successful flights of Soviet people into space.

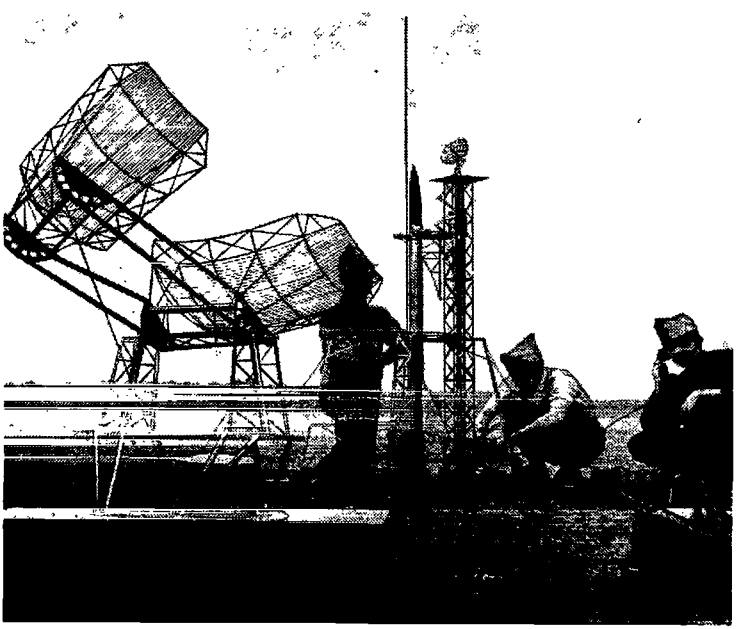
At a small launching pad preparations are in progress for the launching of four rockets. They have been fixed to vertical shafts, and the engines have been connected to a power source.

"Attention!"

The launching site is deserted. At the control desk a new order is expected.

"Start!"

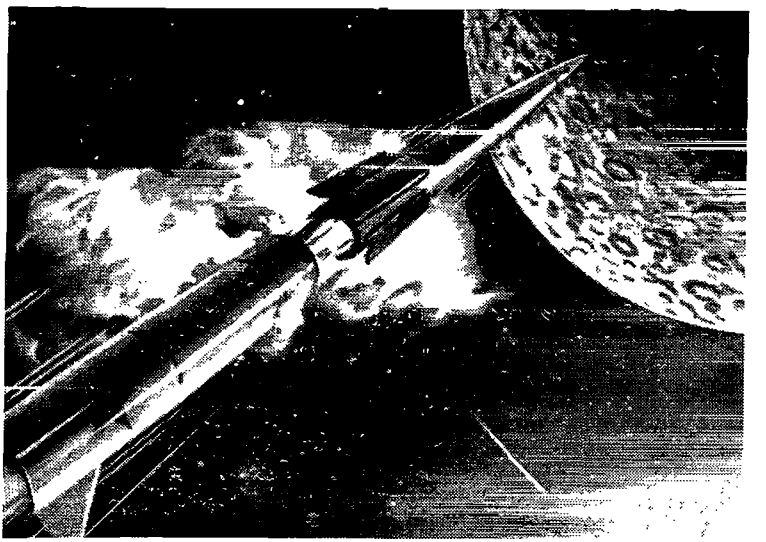
A button is pressed. The current is connected. Roaring and hissing, a flame emerges from the nozzle. For a moment the rocket stands in its place, and then it begins to soar quickly. Not only the eye, but even photographic cameras have difficulty in following its furious rise. The rockets, one after the other, attain a height of 300 meters after four or six seconds trailing a narrow ribbon of smoke behind them. At the very highest point, when the engine has stopped and the rocket has flown many meters by inertia, it should change its path; just then the cupola of the parachute flares open above it...



Future rocketeers.

The spectators, of whom there were many at this launching, ran to the place where they came down. After every success the spectators, the contemporaries of the rocket designers, broke into boisterous rejoicing. One of the adults said: "It's beautiful how the children storm heaven." And that expresses it exactly.

A hundred and seventy young rocket designers took part in the first competition of the Moscow Region for the prize named after Yu. A. Gagarin.



In the outer reaches of space.

Rocket modeling has become a tradition in the life of Soviet youth, similar to modeling in other fields of science and technology.

The age of rockets has begun. The rocket conquers ever new fields of human activity. In the forefront of new scientific and technical discoveries in this direction, too, marches the great Soviet Union.

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